QUANTIFICATION OF EPISODIC CONTROL PROGRAMS

May 1998

QUANTIFICATION OF EPISODIC CONTROL PROGRAMS

20 May 1998

Prepared for

Michael Ball
U.S. Environmental Protection Agency
Office of Mobile Sources
Ann Arbor, Michigan

Prepared by

Karina O'Connor
Brett Koenig
Matthew Naud
Misha Preheim
Lori Duvall

.

Contents

EXECUTIVE SUMMARY

Episodic control programs are targeted public outreach campaigns designed to educate the general public and promote activities that private citizens and the business community can do to improve air quality on high pollution days. These programs emphasize educating the public about air pollution basics (e.g., good ozone vs. bad) and the impact of individual activities on local air quality. Interest in these programs has increased dramatically in recent years, as regions look to identify new ways to address local air pollution problems.

Episodic controls are often implemented to improve air quality and public health, and there is a need to quantify what benefits actually occur. This project, sponsored by the U.S. Environmental Protection Agency Office of Mobile Sources, is one of the first studies to examine the techniques being used to quantify the impacts of current episodic control programs across the country. This report summarizes the results of the final phase of a three-phase project to study episodic control programs. Phases I and II included a scoping study on the state of the practice of episodic control programs in the U.S.; a survey to collect data on each program, and an analysis of the survey results (EPA, September 1997). The final phase documented here is an in-depth examination of the program evaluation techniques being used by episodic emission control programs in five selected areas: Baltimore, Sacramento, San Francisco, Cincinnati, and Dallas. No new data were generated for this project.

A review of the evaluation methodologies of the five selected episodic control programs reveals that surveys of the general public and participating organizations are the most common method used to collect data. Many areas conduct a survey before the pollution episode season to get a baseline understanding of awareness and behavior. Follow-up surveys are then conducted on one or more pollution episode days to assess any behavioral changes that may occur as a result of the program. A few areas have also analyzed indirect measures of effectiveness, such as freeway traffic counts and transit ridership levels, to corroborate any survey findings. However, efforts to evaluate data on indirect measures have yielded mixed results, with most programs finding little or no difference between data on pollution episode days and non-episode days.

All of the programs evaluated have developed methodologies for quantifying impacts, but very few have collected enough data to calculate emission estimates. Most efforts have focused on measuring public awareness levels, perceptions of air pollution, and willingness to take action to improve air quality. The evaluated areas report high public awareness levels of their programs (> 65 percent). Public willingness to take actions to reduce emissions-producing activities on pollution episode days has been measured at between 30 and 80 percent among the various programs. The data suggest that the public are more likely to curtail certain activities, such as use of consumer products and lawn and garden tools, than to reduce driving. Many areas also report consistent trends in the public's perceptions of air quality trends (> 40 percent believe air quality problems are serious and are getting worse).

Little data have been collected on other potential program benefits. For example, through public notification and outreach mechanisms episodic control programs alert susceptible populations (e.g., the young, asthmatics, and the elderly) that air quality on the following day

will be bad and exposure should be limited. To date, there has been no examination of the effect of these programs on the behaviors of sensitive populations. Another benefit that has not been studied well is increases in mass transit use that may be occurring. Cincinnati found that fare subsidies increased transit ridership during the ozone season and this increase continued after the subsidy was removed.

A few programs base their evaluation on the following theory: if they call an ozone action day and the standard is not exceeded, the program is working. While some of the survey instruments reviewed are sufficient to capture basic changes in public awareness levels and program recognition, to date none have included the types of detailed questions necessary to collect meaningful data on the travel and emissions impacts. In short, no program has yet invested the resources necessary to develop a rigorous survey instrument and analytical methodology to quantify the reductions in vehicle travel, and emissions, that may be occurring. This finding is due primarily to two factors. First, most of the programs have not been designed for evaluation. Second, there have been few incentives to invest the significant resources required to perform statistically sound surveys that collect behavior change data. With the new EPA policy allowing states to obtain SIP credit for these programs, there is significantly more interest in developing the necessary analytical techniques and investing in surveys.

1 INTRODUCTION

A number of episodic programs have been implemented throughout the U.S. for the purposes of (1) educating the public, (2) reducing emissions, especially during meteorologically conducive conditions, in an effort to attain or maintain air quality standards, and (3) improving air quality and the public health. Increasing interest in these programs has prompted the U.S. Environmental Protection Agency's (EPA) Office of Mobile Sources (OMS) to develop a more thorough understanding of the programs and to assess their effectiveness in reducing emissions. For this study, data was collected on the episodic control programs currently implemented across the country. An important issue for the EPA is quantifying the effectiveness of the various programs. Episodic control programs, which are usually voluntary, provide information to the public and industry regarding steps that could be taken to reduce emissions. Because the programs are voluntary, traditional methodologies for quantifying effectiveness (which rely on established data such as rule effectiveness) cannot be used to estimate emission reductions. Therefore, estimates of actual changes in individual activities or other program impacts must be assessed using creative and innovative techniques.

This report summarizes the results of Phase III of the study of episodic control programs for EPA. Phase I of the study was an initial scoping task which consisted of gathering information through phone interviews; Phase II involved a more detailed data collection effort, resulting in the development of detailed program profiles for each episodic program. A report describing the procedures used to complete the survey of episodic programs and containing the 36 program profiles was published by EPA in June 1997 (see "Survey and Review of Episodic Control Programs in the United States," EPA-420-R-97-003). Phase III has involved a more in-depth examination of episodic emission control programs for five selected areas (Baltimore, Sacramento, San Francisco, Cincinnati, and Dallas) and of the techniques used to evaluate the effectiveness of the individual control measures included in the programs.

WHY EVALUATE EPISODIC PROGRAMS?

Intermittent controls appeal to areas that have significant emissions from sources such as onroad vehicles, which are traditionally difficult to reduce due to driver behavior. Episodic programs offer additional emission reductions, which historically are not easily obtained on an ongoing basis, during times when the impact of emission reductions is the most critical. Furthermore, continuing public education may reduce emissions over the long term due to increased public awareness of the air quality impacts of changed behavior. Whether episodic controls yield "significant" emission reductions is not clear, although there is supporting anecdotal evidence from some programs. However, an air quality planning agency interested in claiming emission reductions from an episodic control program must first be able to quantify those emission reductions before including the program in a SIP attainment demonstration.[1]

While some areas (maintenance, attainment) may not be interested in claiming specific emission reductions for their episodic programs, they may be interested in including the op-

[1] This statement assumes that the EPA will allow credit to be claimed at some point in the future.

eration of the episodic control program in air quality planning documents such as a maintenance plan. Inclusion of the episodic program would give more legitimacy to the program and open additional avenues for funding (e.g., CMAQ, EPA funding mechanisms). Even though such areas do not need to quantify all emission reductions associated with the program, they should be able to measure the basic effectiveness of the program to show that it meets minimal standards of performance and ensure that the federal air quality planning money is being spent effectively.

Agencies that operate episodic programs (regardless of their motivations) can gain valuable insight by spending a small portion of their resources in evaluating the program's effectiveness. In addition to leading to quantification of program impacts, the evaluation effort can provide valuable feedback on the effectiveness of program components. As with any air quality planning effort that requires staff time and agency resources, periodic evaluation is useful to identify potential improvements for the program. Since episodic programs are voluntary programs, in addition to staff time for planning and implementation of the program, significant resources are required for private and public outreach. The programs also require agency staff to complete tasks (e.g., forecasting and media notification) that they may be inexperienced with and tasks that require significantly more cooperation with other coalition partners. Without an annual comprehensive examination of the effectiveness of all program components, it will be difficult for the lead agency to determine if the program is having any impact and where limited or additional resources should be focused.

WHAT IS BEING EVALUATED?

Episodic control programs are usually voluntary and provide multiple steps that the general public (or businesses) can take to reduce emissions after worse-case meteorological conditions are forecast. The programs emphasize public education on the impact of individual activities on local air quality and the basics of air pollution (e.g., good ozone vs. bad). The education programs are also aimed at informing the public of activities to reduce pollution on both an intermittent "episodic" basis (e.g., reduction of trips) and on a longer term basis (maintenance of cars). During an actual alert day, staff support is needed to forecast the event, to notify the public, employers, and stationary sources, and to survey participation rates. A flow chart in Figure 1-1 illustrates the flow of information and actions during an alert day.

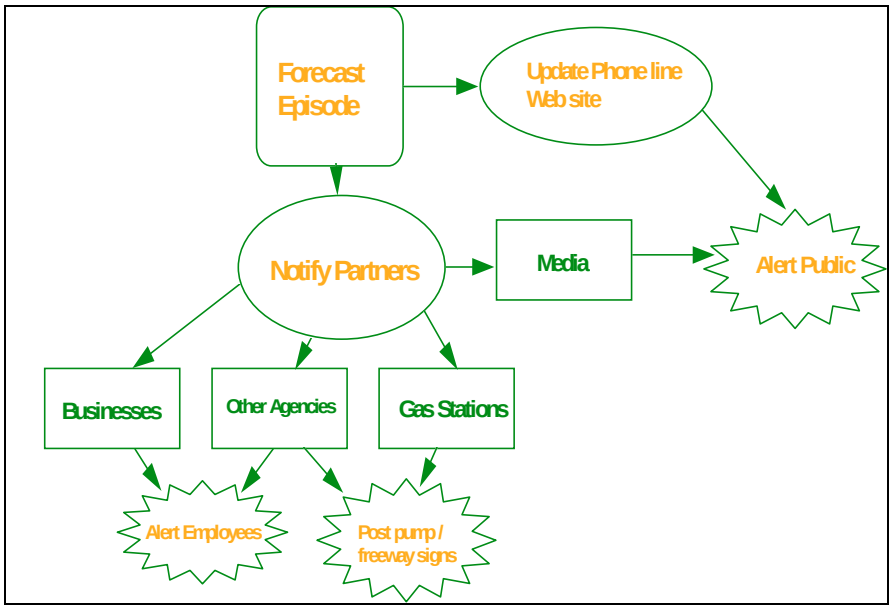


FIGURE 1-1. Flow chart of alert day activities.

The programs are typically directed by a coalition of interested government and business groups who focus the program appropriately considering local sources of emissions, local public acceptance of episodic control measures, and levels of participation of local industry. There are obviously many different activities required to support and implement an episodic control program. Areas operating an ozone alert program, for example, must spend a significant amount of time during the early part of the smog season distributing educational materials and conducting workshops for media and employer participants. These activities are required to ensure that the participants of the program are aware of and understand the appropriate steps to be taken during an ozone alert period. The following core activities are typically undertaken to develop and operate an episodic control program:

- Develop public and employer outreach tools
- Coordinate with local grassroots community and business groups
- Establish control measures/participant actions
- Develop accurate forecasting techniques
- Establish/operate media and business notification network (fax/phone/internet)
- Establish other public notification/advertising tools
- Collect data on impact of the program

It is important to understand that both the activities in support of program development and the activities occurring during episode days need to be completed competently for an episodic control program to be functional and effective. Therefore, to quantify the *impacts* of these programs, we must first examine the *actions* associated with operation of an episodic program on an alert day. However, to evaluate the *effectiveness* of the program, we also need to examine the effectiveness of *each* program component. Quantifying the impacts is needed when we are interested in estimating emission reductions for SIP credit. Evaluating the effectiveness of the program is important if we are interested in understanding the basic functionality of the programs or are interested in improving the program.

Whether we are looking at the actions that result from the program implementation or trying to determine the effectiveness of the individual components, we must first determine which steps or components have quantifiable data. For example, regarding alert day actions: (1) Do we know the number of media contacts and employers notified? (2) How many employees are then notified? (3) Can we measure changes in individuals' (general public or employee's) behavior? (4) Do we know how many businesses are changing their business practices and what these changes are? Examination of individual program components brings up some additional questions: (1) Is the public aware of the episodic alert day program? (% of public) (2) Does the public understand what to do during an alert day? (What actions are being taken?) (3) Is the program being coordinated with all local, significant businesses/employers? (Who is participating?) (4) How accurate are the forecasting procedures?

In addition, to examine the direct impact of the alert day actions or the specific effectiveness of individual components, another potential avenue for evaluating the effectiveness of an episodic control program is to examine the *overall* effectiveness of the program. Overall effectiveness depends upon the initial goals of the program, which can range from improving air quality levels and reducing congestion to educating the public or notifying sensitive populations. Potential sources of indirect data include indicators of regional travel levels (traffic counts, gas sales, transit use), indicators of regional air quality levels (ambient air

quality, complaints to air pollution hotlines), indicators of public health (air quality related hospital admissions), and surveys of public knowledge.

HOW ARE EPISODIC PROGRAMS CURRENTLY BEING EVALUATED?

A variety of techniques are currently being used to quantify the impact of episodic control programs. The most common methods used include surveys of public awareness and knowledge, tracking increased ridership or employer vouchers, examination of congestion and parking data, or review of air quality and meteorological data. These data collection and assessment techniques can be categorized into two methods: (1) direct measurement of program impacts and program effectiveness and (2) indirect measurement of overall program impacts. Direct measurement of a program impact is established when a specific parameter (e.g., number of alert days predicted) can be directly used to estimate the effectiveness of a program component (e.g., accuracy of forecast procedures). Table 1-2 lists the most common forms of direct data analysis. Analysis of regional air quality or traffic trends, in contrast, is an indirect method which can be influenced by factors outside the episodic program. Factors such as variation in meteorological conditions or special events such as baseball games, for example, influence these data and must be accounted for before indirect measures can be used to quantify program impacts. Examples of indirect data sources and some of their confounding factors are listed in Table 1-3.

TABLE 1-2. Direct data sources.

Program Component / Action	Quantifiable Goal	Quantification Method
Public education	Public understanding of air quality issues	Public survey / questionnaire
Community / public outreach	Number of participants Awareness of program/agency	Track number of participants Public survey of awareness
Media outreach	Media hits, accuracy of articles	Track media participation, review articles
Forecasting	Accuracy	Track performance
Notification	Public awareness of alert day	Public survey
Public outreach / program measures	Changes in behavior/emissions	Alert day survey of behavior
Business outreach / measures	Changes in business practices, notification of employees, changes in behavior	Business survey, parking lot counts

TABLE 1-3. Indirect data sources.

Program Goal	Confounding Factors	Quantification Method
Improve air quality	Meteorology	Track air quality trends
Improve public health	Other irritants (allergens)	Track hospital admittance
Long-term lifestyle changes	Other educational efforts, periodic or episodic changes	Survey / focus groups
Decrease regional congestion	Special events (holidays, sporting events)	Collect traffic counts

What specific methods are currently in use for collecting direct and indirect data on the effectiveness of episodic control programs? Table 1-4 contains the specific data collection techniques available for agencies. Most of the data associated with direct measurement are collected using survey techniques. Surveys (typically phone) can be used to examine community understanding, awareness, and changes in behavior. To get more in-depth informa-

tion on motivation and adequacy of specific outreach tools, some areas have conducted small focus group studies. Surveys have also been conducted for subgroups of the general population like employers/employees. These subgroups are often targeted with specific outreach material; development of specific surveys for these subgroups can offer additional insight into the effectiveness of this material. Their actions can also be tracked at specific sites (parking lot counts) or using mechanisms such as travel vouchers. For overall impacts, multi-year trends analysis can be used (with caution) to determine program impacts. Indirect data sources such as transit ridership can be viewed as additional information that programs can use to *corroborate* findings from survey data. While it is difficult to attribute changes in indirect data to specific emission sources because of the many factors which influence their values, analysis of the data can provide valuable supporting evidence of whether an episodic program is working.

Common Pitfalls of Survey Research

Common problems occur with development and implementation of market research efforts. Quantification of the impacts of voluntary programs such as episodic control programs requires the completion of market research efforts such as phone or mail/fax surveys, face-to-face interviews, or focus groups. To obtain accurate and usable data, research efforts should be designed to avoid these common pitfalls. A few major common problems are listed below:

- Survey not focused in intent or scope
- Survey client (agency) not highly involved in survey development
- Design driven by cost/ time, not research goals
- Survey not developed with complete understanding of survey mechanism
- Survey sample size too small
- Results not tied back to original objectives.

To get the most for their money, air quality planning agencies should be intimately involved in the initial design of any research completed to quantify impacts. They should understand that the survey should have clear, measurable research goals. The survey should be designed to measure specific knowledge or actions (changes in behavior). Inclusion of too many or too diverse goals can result in a survey that is time consuming and confusing for respondents. They should understand the limitations of survey mechanisms and chose the correct survey instrument keeping these limitations in mind, rather than the resources or time required to complete the analysis. If subgroups are to be included, the subgroup sizes should be large enough to be useful, and the results should be analyzed with the original research objectives in mind.

LAYOUT OF REPORT

The next five chapters of this report present area-specific information on the data collection and analysis efforts currently underway in the Baltimore–Washington D.C., Sacramento, San Francisco Bay Area, Cincinnati, and Dallas areas. These areas were chosen for an in-depth analysis since they operate episodic programs that are sufficiently different in scope and focus to represent a wide variety of potential programs and geographic areas. All of the areas have expressed interest in developing methods for quantification of emission reductions and two of the areas have completed preliminary emission estimates. However, for the purpose of examining the programs in the context of this report, it should be noted that none of the areas would consider their current efforts as being fully developed enough for submission in a SIP attainment demonstration. Chapter 7 of the report summarizes the lessons learned from examination of the efforts of the five areas. Chapter 8 contains our recommendations concerning quantification techniques.

TABLE 1-4. Detailed list of quantifiable program information.

Direct Measures	Methods to Collect Info
(1) Number of participants	
general public	public survey
# of companies	company survey, direct communication with companies
# employees	company survey, direct communication with companies
# of stationary sources	company survey, direct communication with companies
(2) Public awareness level of program	public survey
(3) Public perception of the air quality problem	public survey
(4) Changes in emission-producing activities	
travel-related activities	
VMT	public survey, company survey
# trips (hot/cold starts)	public survey, company survey
speed (& accel/decel)	public survey, company survey
idling, park time	public survey, company survey
vehicle type used	public survey, company survey
time of day trips are taken	public survey, company survey
frequency of vehicle tune-ups	public survey, company survey
refueling time of day	public survey, company survey
area source activities	
charcoal lighter fluid	public survey
gas-powered garden equipment	public survey, company survey, survey of landscapers using gas-powered equipment
household painting /aerosol use	public survey company survey
company maintenance (painting, degreasing, tank cleaning)	public survey, smokestack plume counts
wood stove and fireplace usage	company survey
stationary source activities	
Indirect Measures	**Possible Sources of Info**
(1) Indicators of regional travel levels	
traffic counts	Transportation and/or planning agency
gas sales	Oil companies and refineries
transit ridership	Transit agency
HOV lane use	Transportation and/or planning agency
car/vanpool program participation	
parking lot usage	Parking lot counts
(2) Indicators of regional air quality	
ambient air monitoring	Air pollution control district, U.S. EPA
visibility	Air pollution control district, U.S. EPA
regional health trends (i.e., ER visits vs. ozone exceedances)	Public health agency, public health literature
complaints to air quality hotlines	Program hotline records

2 BALTIMORE AND WASHINGTON, D.C.—PROGRAM EVALUATION DATA

DESCRIPTION OF PROGRAM AND IMPLEMENTING AGENCIES

The cities of Baltimore and Washington, D.C. are located within 40 miles of each other in the Chesapeake Bay region. Baltimore, along with several surrounding counties, is designated a severe ozone nonattainment area, and the Washington area is classified as a serious ozone nonattainment area. Both cities have created and implemented episodic control programs. During periods when the ozone standard may potentially be exceeded, an alert day is called and participants are asked to voluntarily avoid certain activities (e.g., mowing the lawn, driving to work). Both Washington and Baltimore cite public education of air quality issues as the primary purpose of the program; attaining air quality standards and maintaining public health are secondary goals.

While Baltimore and Washington share a common airshed and many of the same air quality problems, their efforts to deal with pollution episodes are somewhat different. Despite the fact that they both receive funding from many of the same sources and share the same program names (ENDZONE and Ozone Action Days), their episodic control programs are run by different agencies. This has led to some difficulty coordinating activities and overcoming bureaucratic hurdles. Many of these hurdles are exacerbated by the fact that the two cities are situated in different jurisdictions; while Baltimore is entirely within the state of Maryland, the Washington D.C. ozone nonattainment area comprises the District of Columbia, sections of southern Maryland, and northern Virginia. This results in jurisdictional as well as logistical problems in implementing and coordinating the two programs.

In 1993, the Metropolitan Washington Air Quality Committee (MWAQC) began investigating ways to educate the public regarding air quality issues and reducing ozone levels on a voluntary basis. Initially, the MWAQC proposed strict regulations on such activities as public boating and use of lawn mowers on high ozone days. These proposals were part of the *Proposed State Implementation Plan Revision to Achieve a Fifteen Percent Reduction in Volatile Organic Compound Emissions for the Washington DC-MD-VA Nonattainment Area,* otherwise known as the 15% SIP. It became clear that there was substantial public opposition to mandatory controls, and as result, these controls were dropped from the plan and replaced with a voluntary program, called the "Clean Air Campaign." The episodic control program in Baltimore and Washington actually comprises two programs, entitled ENDZONE ("Partners to End Ozone") and "Ozone Alert," both of which are included in the Clean Air Campaign.[1]

The Clean Air Campaign is composed of four elements: (1) public participation, (2) episodic controls, (3) control of unregulated offroad mobile sources, and (4) an employee commute option. Initial funding for the campaign was provided through a combination of local

[1] Seneschal, Jacquelyn Magness, "Public Outreach and Voluntary Actions to Promote Clean Air: The Washington-Baltimore Experience," Metropolitan Washington Council of Governments, Presented at the 89th Annual Meeting of the Air and Waste Management Association, Nashville, TN, June 23-28, 1996, p. 5.

government funds, Congestion Management and Air Quality (CMAQ) funding from the Intermodal Surface and Transportation Efficiency Act, and state transportation funds.[2]

Although all of the programs in the Clean Air Campaign work together, the programs of primary relevance to this study are the ENDZONE program, consisting of implementing agencies and participating employers, and the Ozone Alert program, the primary public notification mechanism of the episodic control program.

The Washington Metropolitan Council of Governments (WCOG) oversees the implementation of the Washington, D.C. area episodic control program. WCOG is responsible for coordinating all sections of the program, from signing up new employer-participants to faxing out alert notices. The Baltimore episodic program is run by the Maryland Department of the Environment (MDE) with assistance from the Baltimore Metropolitan Council (BMC). Both D.C. and Baltimore work with the University of Maryland (UMD) to forecast ozone levels. The two programs have also worked together in the creation of a Ozone Action Day partnership kit which has been distributed to employers participating in the program. The kit contains public education materials for dissemination to employees as well as information designed to assist partners in implementing the program.

The Washington D.C. program (ENDZONE and Ozone Alert) has a 1996 budget of $499,000. Maryland Department of Transportation (MDOT) and the Virginia Department of Rail and Public Transit (VDRPT) each contributed $180,000, the D.C. Department of Public Works contributed $90,000, and WCOG contributed $49,000. WCOG has two staff members who work solely on the program. In 1996, Baltimore's program (ENDZONE and Ozone Alert) received $1,000,000 from the Maryland Department of Transportation and $15,000 from the Amoco Foundation. MDE has four staff members dedicated to the program while the Baltimore Council of Governments (BCOG), BMC, and University of Maryland (UMD) have a total of four additional staff assisting the program.

A summary chart of available data for the Washington, D.C. and Baltimore episodic control programs is presented in Appendix A. The remaining sections of this chapter contain a more detailed discussion of this data. The discussion is divided into two sections, Direct Measures, consisting of survey and forecasting data, and Indirect Measures, which contains a summary of health data.

DATA ON DIRECT MEASURES

The Baltimore and Washington episodic control programs jointly contracted the Gallup Organization to conduct three surveys in early 1995 to assess public awareness of air pollution and the episodic control programs. Survey one, the "General Awareness" survey, was designed to gain an understanding of the level of public education and commitment to air quality issues. In Baltimore, 719 people completed this survey and 985 completed the survey in Washington. The second survey, "Identifying Early Adopters," attempted to ascertain the percentage of people who are knowledgeable of air quality issues in the Baltimore and Washington areas and who are willing to take action on an individual basis to improve air quality. This survey was completed by 267 people in Baltimore and 350 in Washington. A third survey was conducted with area businesses to determine their level of awareness of air quality issues; 241 businesses in Baltimore and 257 businesses in Washington completed

[2] *Ibid.*, pp. 4-5.

this survey. Relevant survey results are discussed below, and complete survey results are presented in Appendix B. Neither Washington nor Baltimore have attempted to assess their respective programs' impact on such things as gasoline sales, transit use, or carpool participation. This may be attributed to the fact that, given limited resources, the programs have tended to focus on public education and outreach, rather than a quantifiable programmatic assessment.

Public Perception of Air Quality Problem

A number of questions from the Gallup survey dealt with public perceptions of air quality in the Washington and Baltimore areas. Questions which focused on public perception of air quality issues included the following:

Which of the following do you feel is of most concern to Washington/Baltimore? (from General Awareness survey)

- air pollution
- water pollution
- disposal of solid waste
- toxic waste
- noise pollution
- accidents at nuclear plants

On a scale of zero to ten, where a '10' means you feel is a very big problem and a '0' means that you feel it is not a problem, how much of a problem do you feel air pollution is in your city or area? (from General Awareness survey)

- There is a problem (7-10 rating)
- In the middle (4-6 rating)
- Not a problem (0-3 rating)

Which of the following do you feel is the biggest contributor to air pollution in your area? (from General Awareness survey)

- Automobiles
- Trucks
- Buses
- Manufacturing/Industry
- Small engine fumes
- Utility companies
- Small businesses

Air pollution was perceived to be the primary environmental problem in both the Washington and Baltimore areas. Thirty-eight percent of respondents in Washington and 37% in Baltimore felt that air pollution was the environmental issue of most concern to them. Respondents were also asked to rate the severity of the air pollution problem in their area on a scale of zero to 10 with 10 indicating it is a very big problem and 0 indicating there is no problem. The results of that survey are shown in Figure 2-1. As shown in the figure, most respondents consider air pollution to be a significant problem in the Washington D.C.–Baltimore area. Many residents identify automobiles as the primary source of the air pollution problem; 52% of those interviewed in Washington and 35% in Baltimore felt that automobiles were the primary cause of air pollution. Few people felt that small businesses (1% in Washington, 3% in Baltimore) or utility companies (3% in both cities) were the primary cause of air pollution.

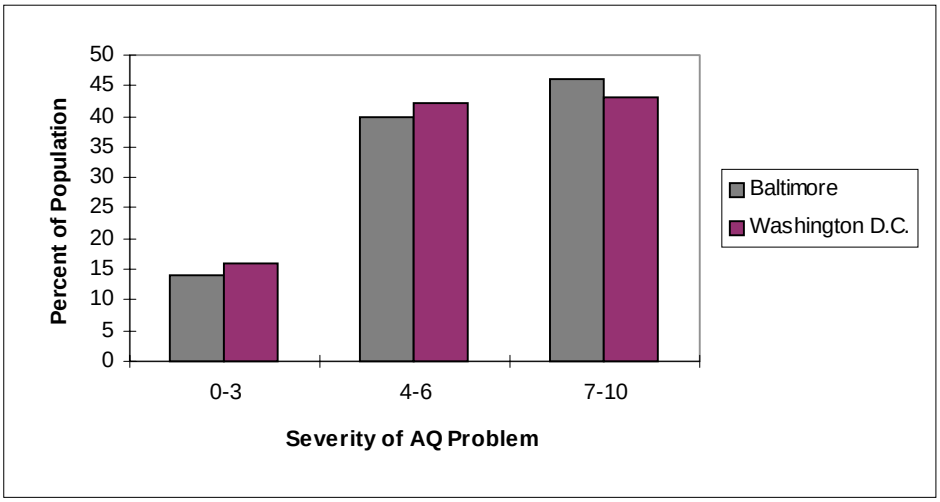


FIGURE 2-1. Survey of public perception.

Public Awareness of Program

A number of questions contained in the Gallup surveys addressed public awareness of the episodic control programs in Baltimore and Washington as well as issues such as who is responsible for cleaning up air pollution in the area. The following questions address public awareness of the episodic control program and responsibility for air pollution problems.

Have you heard of the Air Quality Index/Ozone Alert? (from General Awareness survey and Business Awareness study)

Do you agree or disagree that it is appropriate for employers to share information with their employees that would encourage them to take actions to reduce air pollution, particularly alerting employees of upcoming 'bad air' days — when air quality is expected to be unhealthy? Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly that this communication is appropriate for employers to make? (from General Awareness survey)

"Who do you think is responsible for reducing air pollution and cleaning up Washington's/Baltimore's air?" (from General Awareness survey and Business Awareness survey)

- Everyone/each of us
- State government
- Federal government
- Factories or industrial sites
- Automobile manufacturers
- Cities/communities
- Businesses
- Other

Eighty-five percent of Washington respondents have heard of the "Air Quality Index" (forecasting is presented to the public under this title in Washington) while 44% have heard of an "Ozone Alert" in Baltimore. The percentage of businesses that have heard of the programs is substantially higher (97% in Washington and 47% in Baltimore). Most residents seem to believe that businesses and employers can play a role in helping to notify employees of alert

days. Forty-three percent of residents in Baltimore and 49% in Washington strongly agree that it is appropriate for employers to alert employees of upcoming "bad air" days; 32% of respondents in Baltimore and 34% in Washington agree that this is somewhat appropriate.

Most respondents indicated that all of us are responsible for improving air pollution. The survey results for this question are shown in Figures 2-2 and 2-3. When the general public was asked who they feel is responsible for reducing air pollution, 49% of respondents in Washington, and 47% in Baltimore indicated that every one of us is responsible. In comparison, when businesses were asked to respond to the same question, 42% interviewed in Washington and 35% in Baltimore indicated that they felt we are all responsible for reducing air pollution. It is also interesting to note that 1% in Washington and 5% in Baltimore felt that factories or industrial sites were responsible and only 5% in Washington and 4% in Baltimore indicated that automobile manufacturers were responsible for cleaning up the air.

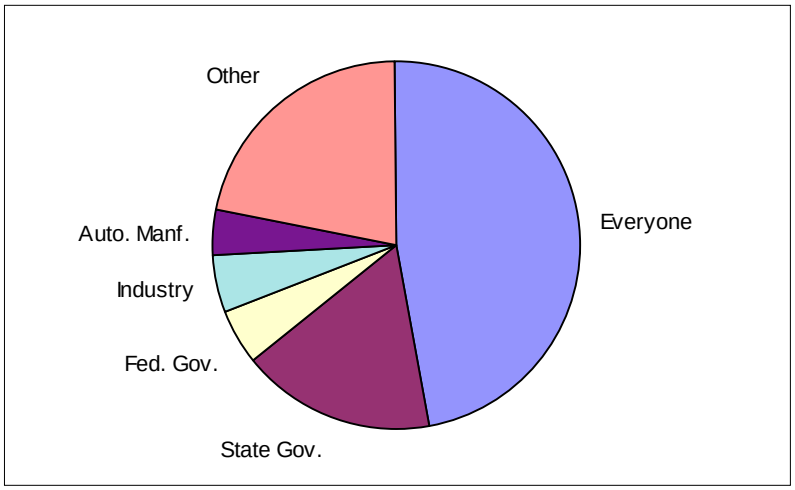


FIGURE 2-2. Responsibility for improving air quality in Baltimore.

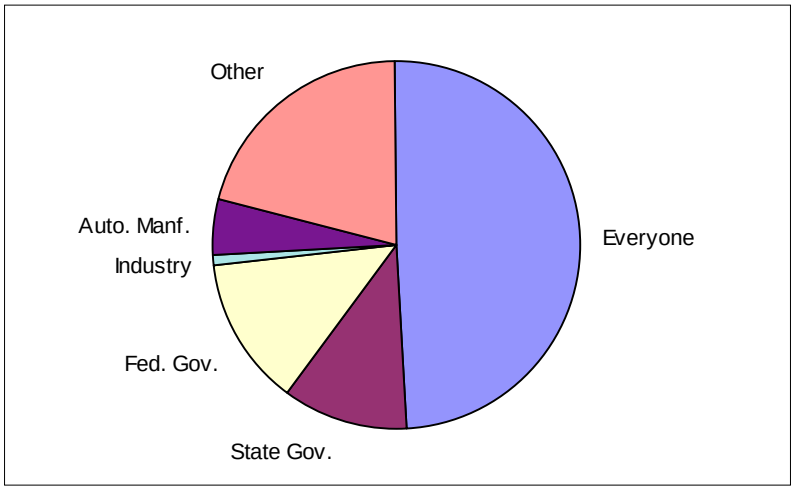


FIGURE 2-3. Responsibility for improving air pollution in Washington.

The Baltimore survey was also able to include the question "Have you heard of an Ozone Alert" in a survey of Inspection / Maintenance programs which was conducted in early 1996.

The results indicated that 61% of respondents have heard of an Ozone Alert. This figure was 44% when the question was asked in the 1995 survey.

Participation Levels

The Washington and Baltimore programs have worked to identify the effects of the public-private partnership known as ENDZONE. As mentioned above, the ENDZONE partnership plays a significant role in implementing many of the control strategies in the episodic control program. It was estimated that by the end of the first season, ENDZONE had signed up more than 40 partners and, as a result, had reached more than 2.5 million people as a result of public outreach and employer efforts.[3] Appendix C lists organizations in the Baltimore area planning to implement ozone action day plans as of July 2, 1996 (members of ENDZONE).

Both programs have also attempted to ascertain how many "impressions" were generated by the Clean Air Education Campaign.[4] It was estimated that between May and September of 1995, the campaign generated 55.1 million media impressions. Of the 55.1 million impressions, 27.5 million were estimated to be generated by the ENDZONE private sector partners (such as utilities which included forecast information in monthly bills, and employers who notified employees of episode days), 13.1 million impressions were generated by the air quality forecast, 8.1 million impressions from media coverage (particularly Code Red days), and 6.4 million impressions from public service TV and radio spots.[5]

Changes in Emission Producing Activities

Even though the Baltimore-Washington program did not complete any alert-day specific surveys to measure actual participation, the Gallup surveys attempted to gauge public and employer willingness to take action to improve air quality.

> Would you be very willing, somewhat willing, not very willing, or not at all willing to personally take actions that would reduce air pollution?" (from General Awareness survey)
>
> If you know that the following could help reduce air pollution in your area, how willing would your company be to do each of the following on a voluntary basis?" (from Business Awareness study)
>
> - share information with employees on bad air days
> - offer rideshare programs
> - be part of business partnership

Many residents seem willing to take action to alleviate air pollution, as shown in Figure 2-4. The most encouraging responses were the 33–39% that indicated that they would be very willing to take actions that would reduce air pollution. Regarding local businesses, 54% in Baltimore and 47% in Washington indicated that they would be willing to share information with employees on bad air days, 15–20% would be willing to offer rideshare programs to employees, and 18–25% would be willing to join a business partnership to reduce air pollution.

---

[3] *Ibid.*, p. 5.

[4] An 'impression' was defined as the total number of messages that viewers, listeners, or readers heard or viewed via broadcast or publication, *ibid.*, pp. 8.

[5] *Ibid.*, pp. 8-9.

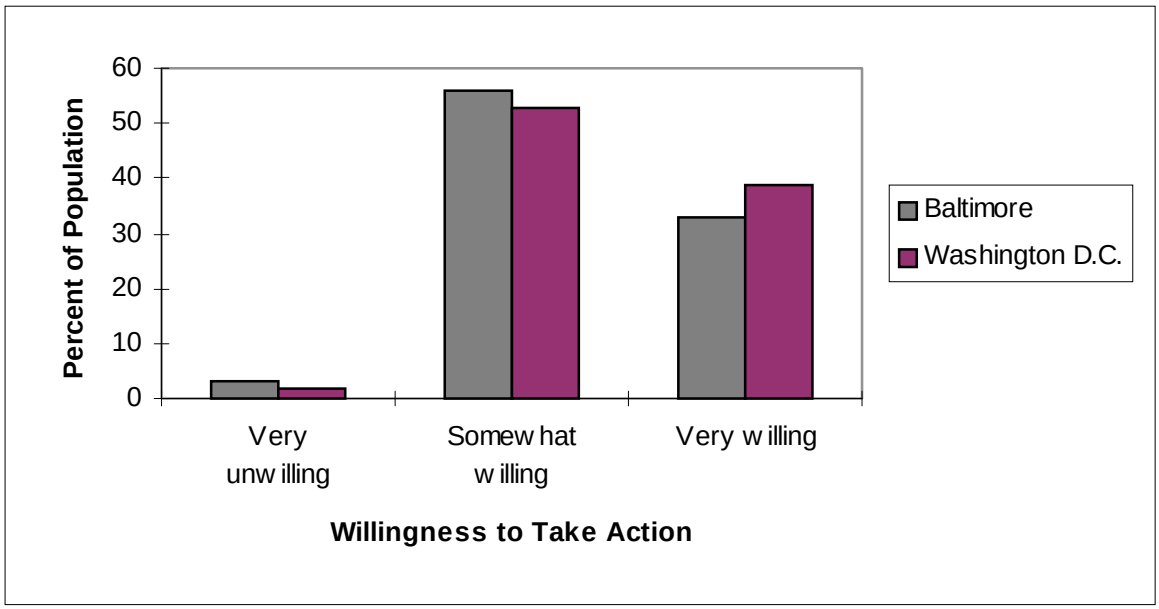


FIGURE 2-4. Public willingness to participate.

With regard to actual changes in behavior, the following question was included in the General Awareness survey given early in 1995.

> Have you taken action or behaved differently based on hearing or reading about the Air Quality Index / Ozone Alert? (General Awareness survey)

In Washington 39% and in Baltimore 16% of respondents reported having taken action or behaved differently as a result of hearing about the Air Quality Index or Ozone Alert. While the percentage of businesses that have heard of the programs (as reported earlier) is higher than the general public (97% in Washington and 47% in Baltimore), fewer businesses reported taking action in response to the program (10% in Washington and 8% in Baltimore). The percentage of individuals who have taken action increases substantially when limited to people who indicated that they have heard of the respective program. Of those who have heard of the program, 46% in Washington and 36% in Baltimore have taken action or behaved differently.

Both programs also attempted to determine how many people can be considered "early adopters." Early adopters were defined as persons who recognize the air pollution problem, agree that air pollution has negative consequences, agree that they contribute to the problem, and are willing to take action. In Baltimore, 34% of respondents were early adopters, while in Washington, 35% fell into this category. Interestingly, in both areas, the percentage of respondents who were early adopters was higher among city residents than among residents of suburbs.

Forecasting Abilities

Forecasting for both programs is based on data supplied by the University of Maryland Department of Meteorology.[6] The ozone level forecast is determined based on a regression equation and a subjective consensus made by UMD staff and MDE. The regression equation includes the following inputs:

- Surface wind speed and direction
- Total opaque sky cover
- Daily maximum and minimum temperatures
- Upper air variables (geopotential height, temperature, and wind speed and direction)
- Previous day maximum ozone
- Day length
- Inversion parameters

As mentioned above, the regression equation is only part of the forecasting methodology. A subjective process is also used whereby UMD and MDE forecasters adjust the regression inputs to account for local influences which are not considered in the regression equation.[7] Secondly, the forecasters use their own knowledge of synoptic weather patterns and historical air quality to derive an educated guess. The forecasters then compile all of this information and select a final maximum ozone concentration. The forecast is color coded and is based on the scale shown in Table 2-1. This forecast is then converted to a number on the Pollutant Standard Index (PSI) and is reported in the weather section of participating daily newspapers.

TABLE 2-1. Air quality forecast scale.

Code	Ozone Concentration (ppb)	Forecast Message
Red	125+	Unhealthful Air Quality
Orange	110–124	Approaching Unhealthful
Yellow	63–109	Moderate Air Quality
Green	0–62	Good Air Quality

To help examine the accuracy of forecasting method used in Baltimore, data for the summer of 1995 were analyzed. The University of Maryland was contacted to obtain information on which monitoring sites are used to determine ozone exceedances. In addition, dates for which forecasting models predicted unhealthy air were also obtained. Same-day (morning) model forecasts of ozone concentrations in excess of 125 ppb in the Baltimore–Washington area were made for nine days during the summer of 1995. As seen in Figure 2-5, ozone exceedances (of the federal standard of 125 ppb) were observed on each of the forecast days. In addition, seven other days were also in exceedance of the ozone standard. Ozone exceedance information was based on the ozone concentrations of 35 air quality sites within the Baltimore–Washington region.

[6] The information in this section is based on the paper, "Ozone Forecasting and the Ozone Map; Innovative Public Education Tools on Ground Level Ozone in Maryland," by Eric D. Luebehusen, presented at the 89th Annual Meeting & Exhibition of the Air and Waste Management Association, Nashville, Tennessee, June 23-28, 1996.

[7] For example, land/sea breezes and the urban heat island are not accounted for in the model.

The Maryland Department of the Environment also reported the statistics shown in Tables 2-2 and 2-3 regarding the accuracy of the forecasts in 1995. The overall forecasting accuracy for 1996 appears to be approximately 81%, a figure which is identical to the accuracy percentage from 1995.

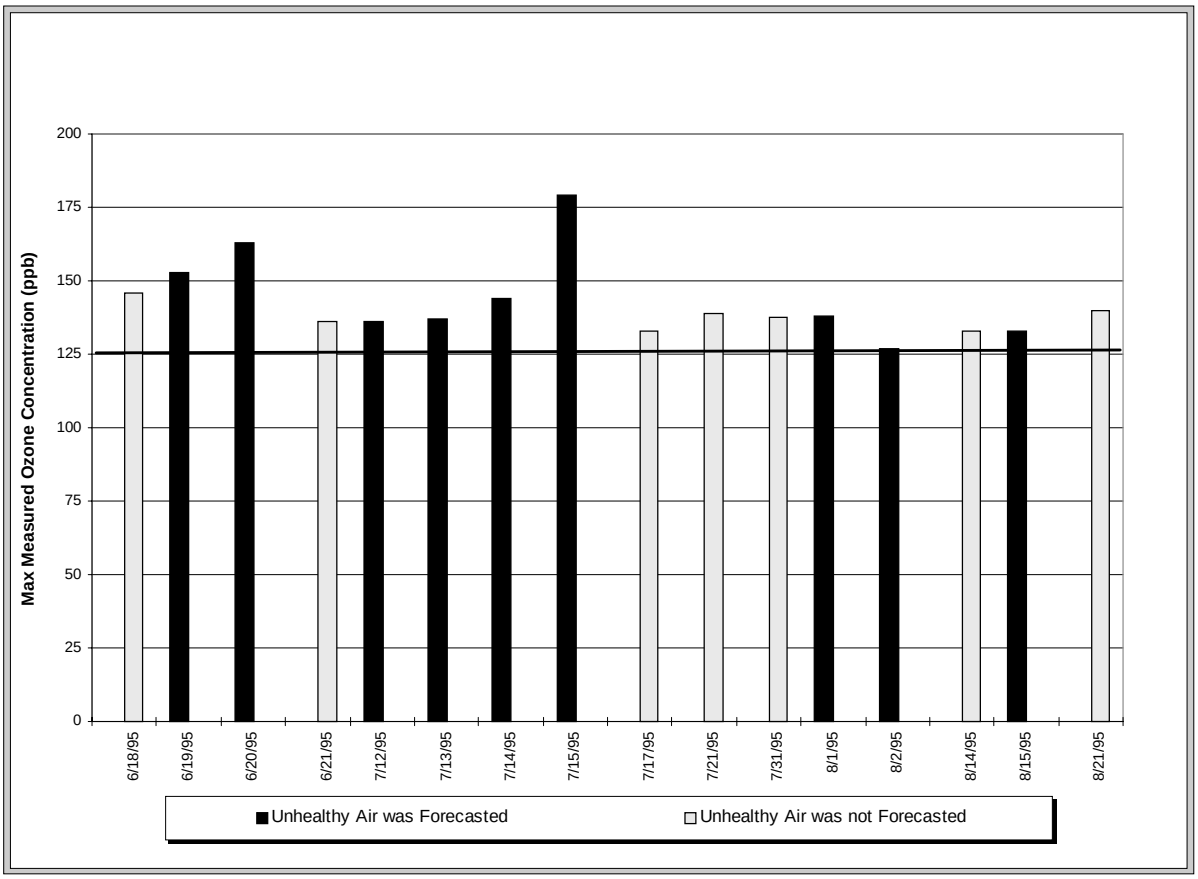


FIGURE 2-5. Forecasting accuracy in 1995.

TABLE 2-2. MDE 1995 ozone forecasting summary.[8]

Measure of Forecast Skill	24 Hour Forecast	12 Hour Forecast
Probability of Detection:		
Code Orange or Red Issued on Actual Ozone Violation Day	71%	71%
Miss Rate:		
Code Yellow or Green Issued on Actual Ozone Violation Day	29%	29%
False Alarm Rate:		
Code Orange or Red Issued, Observed Ozone < 110 ppb	27%	23%
Code Orange or Red Issued, Observed Ozone < 100 ppb	5%	5%
General Accuracy: All Forecasts:		
Correct Code Only	81%	81%
Correct Code OT within 10 ppb of observed max	86%	86%
CNULL: Clean Conditions Forecast Accuracy		
Code Yellow or Green Issued, Observed Ozone < 110 ppb	88%	89%
Code Yellow or Green Issued, Observed Ozone < 100 ppb	97%	95%
True Skill Score (TSS) - Observed Skill: Perfect Skill		
If all forecasts are correct, TSS = 1, if all are incorrect, TSS = –1	0.68	0.66

TABLE 2-3. 1995 consensus numerical forecast accuracy.[9]

Forecast Accuracy	24 Hour Forecast	12 Hour Forecast
Overpredict ozone	51%	45%
Underpredict ozone	42%	50%
Direct Hit: Ozone predicted = ozone observed	7%	5%
Predicted Ozone within 5 ppb of Observed	47%	39%
Predicted Ozone within 10 ppb of Observed	64%	62%
Predicted Ozone within 15 ppb of Observed	75%	81%
Mean Forecast Error, All Forecasts	11.29 ppb	10.11 ppb

TABLE 2-4. 1996 estimated forecasting summary for Baltimore.[10]

Forecast (May 16–Sept. 16)	Issued	Valid	Percent of forecasts correct
Number of Green Forecasts	21	16	76 %
Number of Yellow Forecasts	85	71	84%
Number of Orange Forecasts	9	1	11%
Number of Red Forecasts	1	0	0%
Orange Forecasts w/ozone >100	9	4	44%
Orange Forecasts w/ozone > 105	9	4	44%
Number of Correct Codes	116	94	81%
PPB Error = +/- 12.6			

[8] *Ibid.*, p. 8.
[9] *Ibid*.
[10] This chart was provided by the Maryland Department of the Environment.

DATA ON INDIRECT MEASURES

Public Health Trends

In June of 1996, the Harvard School of Public Health released a study conducted for the American Lung Association which examined the effects of low-level ozone on hospital admissions and emergency room visits for respiratory problems.[11] The study found that exposure to high levels of tropospheric ozone was linked with a total of approximately 10,000 to 15,000 hospital admissions and 30,000 to 50,000 emergency room visits for respiratory conditions in 13 U.S. cities. Among those cities were Washington and Baltimore. While this information does not in any way constitute an assessment of either the Baltimore or Washington programs, the information could be used to assist in such an assessment at a later date. For example, the programs might conduct a follow-up to the Harvard study and determine how hospital admission rates have changed in later years. While there are numerous variables to consider in such an assessment, it might serve as one indicator of air quality and program success. It is worth noting that in the Gallup survey, a significant number of businesses indicated that a lack of information regarding health effects of pollution is a primary reason they are not doing more to ameliorate air pollution levels. 41% of businesses surveyed in Baltimore and 33% in Washington indicated that they would be more likely to take action if they had more information regarding the health effects of air pollution. This figure increases substantially if businesses had information linking air pollution with increased health insurance or decreased employee productivity.

Hospital admission data were collected from states that are legislatively required to gather hospital data. For the Baltimore area, as well as the Maryland suburbs of Washington, the Maryland Health Services Cost Review Commission provided data. Data for the District was provided by the Washington Hospital Association, although federally run hospitals, some psychiatric hospitals, and some specialty hospitals are not included. Data on ambient ozone levels were obtained from the EPA's Aerometric Information Retrieval System (AIRS) database. The methodology used to project the acute effects of ozone on hospital admissions was derived using a synthesis of results, published in peer-reviewed journals since 1992, of daily effects of ozone on respiratory admissions. Using this information, a weighted average ozone coefficient was derived for each of the 13 cities examined. During the ozone season, average ozone contribution to total admissions for respiratory conditions was estimated to be approximately 7 to 8%.

In the Baltimore area, it was estimated that an average of 664 hospital admissions (7.9% of total admissions) were attributable to ozone during the high ozone season. In addition, an average of 1992 emergency room visits were attributable to ozone during the high ozone season (also 7.9% of total).[12] In the Washington area, it was estimated that an average of 599 hospital admissions (7.6% of total admissions) were attributable to ozone during the high ozone season. An average of 1797 emergency room visits were attributable to ozone during the high ozone season (also 7.6% of total).

---

[11] Ozkaynak, Haluk, et al., *Ambient Ozone Exposure and Emergency Hospital Admissions and Emergency Room Visits for Respiratory Problems in Thirteen U.S. Cities*, Harvard University School of Public Health, June 1996.

[12] Because the authors were not able to obtain data on hospital admissions, they estimated that one in three emergency room visits results in a hospital admission, hence a multiplier of 3 was used to derive this figure. Consequently, the "percentage of total figure" also remains the same between hospital admissions and emergency room visits.

While the Harvard study does not necessarily address all factors involved in hospital admissions and ozone levels, it is especially relevant because it strengthens the basis for much of the work being conducted by programs like Ozone Alert and provides added credibility to the concept that episodic control programs, if successful, can have a significant impact on human health, particularly in cities with high ozone levels. The health affects of ground-level ozone have been well documented and can be particularly detrimental to individuals in certain groups, such as children, the elderly, and asthmatics. If episodic control programs are successful in limiting the extent and magnitude of ozone pollution episodes, they may well serve an important public health role. Their success depends largely on participation levels and public awareness of the program.

3 SACRAMENTO — PROGRAM EVALUATION DATA

DESCRIPTION OF PROGRAM AND IMPLEMENTING AGENCIES

The Sacramento "Spare the Air" program was created in May 1995 following the success of the San Francisco Bay Area episodic control program of the same name. Like San Francisco's, the Sacramento program is a targeted public outreach effort to discourage emission-producing activities, particularly automobile use, on days of poor air quality. The Spare the Air program is the episodic element of the Sacramento Metropolitan Air Quality Management District's (SMAQMD) Summer Smog Season public education campaign that began in 1990. Both campaigns run from May through October. SMAQMD implements Spare the Air with the cooperation and support of the air districts throughout the Sacramento Valley region. To assist with surveying and program evaluation, an alliance has been formed with the Cleaner Air Partnership of Sacramento (CAP), a joint project of the American Lung Association and the Sacramento Metropolitan Chamber of Commerce which joins business, government, and environmental interests to reduce transportation sources of air pollution.

SMAQMD has developed an extensive public outreach campaign which includes mass media advertising, news coverage, employer participation, and neighborhood outreach. Significant resources have been allocated to maximize public exposure to the program. In 1995, 60% of the program's $232,000 budget was spent on outreach materials and media advertisements. Of this, $54,500 was spent on promotional items such as brochures, notepads, and magnets for distribution to the general public, and participating companies and their employees. The other $85,000 was spent on 96 television and 237 radio advertisements during the course of the 1995 Spare the Air season. The 1995 Spare the Air Final Report states that 86% of the target audience (adults 18–49 years old) saw or heard the ads from the 1995 campaign. The average number of times the target audience saw or heard the ads was 7.9 times. Although the effectiveness of other outreach methods including news coverage, employer outreach, and neighborhood outreach is not as well known, it is expected that they too are increasing public awareness of the program.

A summary chart of available data for the Sacramento episodic control program is presented in Appendix A. The remaining sections of this chapter contain a more detailed discussion of these data. The discussion is divided into two sections, Direct Measures, consisting of survey and forecasting data, and Indirect Measures, which contains a summary of regional transit and traffic data.

DATA ON DIRECT MEASURES

Since the inception of the program, SMAQMD has undertaken an ambitious effort to collect data on the effectiveness of the public outreach efforts and the overall effectiveness of the program. These efforts are reflected in the annual Spare the Air budget, which allocates approximately $47,000 for survey design, polling, and data analysis. SMAQMD's contribution of $47,000 covered approximately 70% of the total data collection and analysis cost; the other 30% was paid for by the other air districts in the region. Several survey instruments

have been developed and used by SMAQMD to collect data on the main indicators of program effectiveness: program participation levels, public awareness level of program, and changes in emission-producing behaviors of participants. In addition to the surveys, data on forecasting accuracy, traffic counts, and transit data have been obtained from other agencies and organizations.

Over the years the SMAQMD has provided funding to the Cleaner Air Partnership of Sacramento for surveys design, polling, and data evaluation. With these funds CAP has conducted an annual Air Quality and Transportation public opinion survey since 1989. This survey has been revised several times since 1989 but continues to focus on collecting information on changes in the public's use of alternative modes of transportation and in their perception of the air quality problem, over time. Starting in 1995 a second type of surveys, Spare the Air "minipolls," were used to collect data on changes in travel behavior on Spare the Air days. The District expects the minipolls to be a better survey instrument for collecting accurate travel behavior data since they are conducted within a day of the Spare the Air episode, whereas the annual surveys are conducted only once yearly in the fall. The difference is that minipolls ask participants about their travel behavior on that day or the day before whereas the annual surveys ask participants about changes in travel behavior that occurred several months earlier. All total, 12 surveys have been conducted by SMAQMD and CAP—an annual survey since 1989 and two minipolls in 1995 and 1996. The data collected from these surveys, as reported by SMAQMD and CAP, are discussed below.

Public Perception of Air Quality Problem

Over seven years of survey data have been collected to assess changes in the public's perception of the air quality problem in the Sacramento region. Several questions have been asked in the annual Air Quality and Transportation public opinion survey to learn how the public perceives air pollution. The air quality questions in 1995 survey include the following:

Would you say that air pollution or smog in our metropolitan area is ... (*Question 1*)

- a very serious problem
- a somewhat serious problem
- not a very serious problem
- not a problem at all

Over the past two years, would you say that air pollution in our metropolitan area has ... (*Question 2*)

- gotten worse
- stayed the same
- gotten better

Would you say that smog in our area is ... (*Question 3*)

- worse in the winter
- worse in the spring
- worse in the summer
- worse in the fall
- about the same all year

"What would you say is the major cause of air pollution in our metropolitan area?" (*Question 4*)

In general, the data show that more people feel air quality is a serious problem than they did in 1989. The percentage of people in the Sacramento Valley who feel that air pollution is a "very serious" problem has increased from 41% to 50% from 1989 to 1995. In specific counties, like Placer County, more dramatic trends have been seen with the percentage reporting air pollution as "very serious" increasing from 29% in 1993 to 49% in 1995. The percentage reporting that air pollution was either "very serious" or "somewhat serious" was 89% in 1995. Sixty-six percent of Sacramento residents in 1995 reported that the air pollution trend is has "gotten worse" compared to 25% who report it "stayed the same" and 4% who feel it has "gotten better." This perception has remained unchanged since 1989 where the same percentage of the population reported that air pollution was worsening.

Several questions have been asked to determine how much the public has learned about the causes of air pollution. In 1995, 64% of respondents correctly answered that air pollution is worse in the summer, compared to 45% in 1989. In 1995, when asked what was the major cause of air pollution in the area 76% of respondents reported "automobiles/vehicles." Since this question was only asked in 1991 and 1995 it is unclear what the longer term trend is, but the data from these two years suggest that this perception has changed little over time.

In short, these data show that there has been a general increase in awareness about the air pollution problem by residents of Sacramento over the last seven years. The current survey design does not allow the air district to determine to what extent these changes in public perception are directly attributable to the Summer Smog Season or the Spare the Air campaigns. While it may be difficult to directly attribute all of the changes in public perception directly to these educational outreach efforts, it is expected that the extensive resources spent for mass media advertising and other outreach mechanisms have contributed to these trends.

Public Awareness of Program

The SMAQMD and CAP surveys have never directly asked the public whether they know about the Spare the Air program or recognize its slogan. The Sacramento program's interpretation of "awareness" is different from that of most programs which use the term to mean the level at which the general public recognizes the program, its name, and its goals. Instead, the Sacramento program is more interested in whether the public has heard the program's *message*. Data on what percentage of the public has heard the message has been collected from both the annual Air Quality and Transportation public opinion survey and the Spare the Air minipolls. The following surveys questions are used to elucidate this information:

> In the past week, have you seen or heard anything about air pollution in our metropolitan area? (*Question 5 - Spare the Air minipoll*)
>
> Do you recall being asked not to drive on (insert date) because our area was experiencing a period of unhealthy air?" (*Question 6 - Spare the Air minipoll*)
>
> Last summer, about how many time did you hear that we were in a period of unhealthy air quality and that everyone was being asked to reduce driving?" (*Question 7 - Air Quality and Transportation survey*)

In both surveys, these questions were only asked of drivers. Currently awareness levels of nondrivers is not being tracked. The agency assumes that the percentage responding "Yes" to Question 8 represents the percentage of drivers that are aware of the program's message. During two pollution episodes in 1995, one weekday, the other a weekend, Spare the Air

minipolls were conduced. The percentage of drivers (on the weekday and weekend) who responded "Yes" to question 8 were 80% and 58%, respectively. The large difference in awareness levels on weekend and weekday may reflect the fact that on the weekend people are more likely to be out of their normal social sphere (home, work, etc.) and therefore may have fewer contacts with information sources from which they would normally hear the Spare the Air day message. This compares with the 1996 minipoll results which show that 73% of respondents reported being aware of the request not to drive. From the Air Quality and Transportation survey (question 7 above), 77% of all drivers responded "one or more times." From this, the percentage of the population that was aware of the program's message was determined to be 77%.

Participation Levels

For the Sacramento program, participation in the program occurs when an individual or company takes certain actions to reduce emissions on Spare the Air days. Since the main source of pollution in Sacramento is automobile emissions, changes in travel behavior are especially encouraged. Participation levels for the Spare the Air program have been estimated by polling the general public and registering companies as official participants in the program. The SMAQMD has registered 137 companies, representing over 150,000 employees, as official partners in the effort to improve regional air quality. By registering with the program these companies have agreed to notify their employees when a Spare the Air Day is declared and educate them about actions they can take to reduce pollution on those days. These companies represent a wide array of public and private interests; some of them include Aetna, Blue Cross of California, State of California (various agencies), Campbell Soup, City of Sacramento, Hewlett Packard, Intel, Kaiser Permanente, PG& E, and Wells Fargo Bank. Many other unregistered companies also receive notification of the Spare the Air day through the program's fax distribution network; however, it is not known how many additional employees are notified by these companies. It is also not known what percentage of employees from registered or unregistered programs are actually changing their behavior after they are told about a Spare the Air day. Therefore, estimates of the number of people that are notified through their employers provides only an upper bound on the possible number of employees that are participating.

Changes in Emission Producing Activities

Travel related activities: Sacramento has undertaken an ambitious effort to collect data on any changes in travel behavior that have occurred in response to the Spare the Air program. Since 1989 questions have been included in the program's annual Transportation and Air Quality survey to estimate changes in the use of alternative modes of transportation. Starting in 1995, SMAQMD began using minipoll surveys to collect more accurate travel data by asking the public *on* a Spare the Air day whether they changed their behavior that day, and if so, why. The use of the minipolls for collecting travel behavior information was an improvement in methodology for the program and increased the reliability of any analyses performed on the data. Since 1995, Sacramento has performed three minipolls to collected data on Spare the Air days. From these efforts the following travel behavior data has been collected:

Annual Survey (8 Years of General Travel Data):

Changes in the number of round trips taken per month by various alternative modes of transportation (car/vanpool, transit, light rail, walking, biking)

Mini-polls (2 Years of Data on Spare the Air Day Travel Behavior):

Percent of people reducing driving

Percent of people reducing trips

Average number of round trips reduced per day for those who reduced trips

Average number of round trips reduced per day for all drivers

Average number of daily trips per driver reduced through:

- delaying trip to another day
- car/vanpooling
- taking transit
- walking or biking

Average number of:

- work trips reduced per driver per day
- freeway trips reduced per driver per day

Total driver round trips per day reduced

Estimates of the number of people that have reduced driving on Spare the Air days have been obtained from analysis of survey results. For those respondents that answered 'Yes' to the mini-poll awareness question (Question 6 above), the following question was asked to collect information on whether they were actually participating:

In response to this request not to drive, did you actually reduce your driving? (*Question 8 - Spare the Air minipoll*)

Analysis of the responses to this question from the 1995 weekend and weekday minipolls are shown in Figure 3-1. The 1995 data compare well with the 1996 minipoll results, which show that 33% of respondents reported reducing the number of trips they took. The 1996 minipoll was conducted on a Spare the Air episode which coincided with both a weekday and weekend (Thursday through Saturday) so results may not be directly comparable with those from 1995.

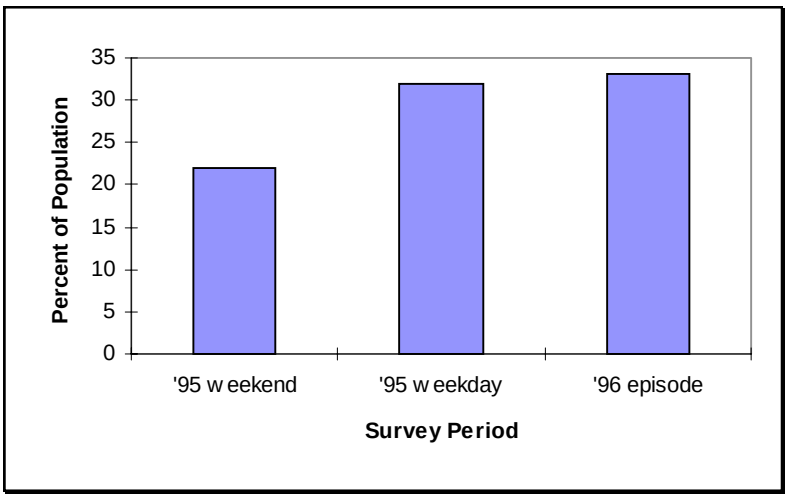


FIGURE 3-1. Reduction in driving on alert days.

Additional questions were asked to determine what drivers who reported reducing trips did instead of driving. The percentage of respondents that reported "delaying trips to another day" was 12% and 20% in the 1995 weekend and weekday surveys. This compares with the 1996 (Thursday through Saturday) minipoll results which show that 21% respondents delayed trips to another day. The second and third most common activities that respondents did instead of driving were "carpooled/vanpooled" with 14%, and "walked" with 10% of responses in 1996.

The wording of question 8 in the minipolls allowed SMAQMD to determine whether respondents who report reducing travel on Spare the Air days did so in response to the campaign's request to reduce travel. This question is key because its helps to establishes causality between the action and the campaign's message thereby allowing the Spare the Air program to directly claim credit for reducing that individual's travel. Some additional travel-related activities that are not currently tracked by the program include the type of vehicle use, the time of day trips are taken, and the time of day vehicles are refueled. A second class of mobile source that is also not being tracked is offroad vehicle use (such as motorcycles and boats) on Spare the Air days.

While the Sacramento surveys are among the most comprehensive attempts to obtain travel behavior data on pollution episode days in the nation, a couple of potentially important travel-related issues are not addressed in the surveys. The surveys do not ask whether a vehicle left at home by the respondent on a Spare the Air day was used by someone else in the household during that time. A second issue which is not captured is whether people drove their car to a Park-and-Ride lot to catch a carpool or transit. In either of these situations, any emissions benefit expected will be lessened or not realized at all. Inserting additional questions to identify these respondents will improve any travel and emissions estimates made from the survey data. Not including them could cause overestimation of the travel and emission reductions attributed to the program, although it is unclear by how much.

Emission estimates: Using data collected in the Spare the Air minipolls from 1995 and 1996, the Sacramento program has estimated the reductions in mobile source emissions attributable to the Spare the Air program. The general methodology was based on data collected from questions 6 and 8 (above) which asked people whether they actually reduced their driving on Spare the Air days in response to the program's request not to drive. These

people were then asked what they did instead of drive, and how many round trips they reduced by postponing trips or taking an alternative mode of transportation. From this, the percentage of drivers in the survey that reduced trips and the number of trips reduced per driver was determined. With this information, vehicle registration statistics, and average trip length data, estimates of the number of total trips and VMT reduced in the Sacramento region were made through extrapolation. To obtain the registration, trip length, and emission factor data needed to complete the emissions estimates, the Sacramento program received guidance from the Sacramento Area Council of Governments and the California Air Resources Board. The data used to calculate the daily reductions in mobile source emissions from the August 1996 Spare the Air episode is as follows:

No. of Drivers in Sacramento, Placer and Yolo/Solano Counties	= 875,800
Average No. trips reduced/driver on Spare the Air days	= 1.04 trips/day
Average home-based trip length	= 4.0 to 5.7 miles
Average ozone precursor (HC + NOx) emissions per trip end	= 5.11 grams/trip[1]
Average ozone precursor (HC + NOx) emissions per mile	= 1.30 grams/mile

Assuming a 1 mile average trip length, the Sacramento program estimates a reduction of 6,631 kg (or 7.3 tons) of ozone precursors per day attributable to the Spare the Air program during the August 1996 episode. For each additional mile assumed for the average trip reduced, approximately 1.5 tons of ozone precursors can be added to the total. If an average trip length of 5.7 miles is used, then total ozone precursor emissions reduced is approximately 14 tons/day. This translates into a 15% reduction in the total light duty auto emission inventory of 93 tons.

The degree of certainty that can be attributed to this emissions estimate is unclear at this time. Sacramento continues to refine its analysis, however, by improving its surveying methodology and identifying other sources of data (traffic counts, etc.) with which to corroborate the survey findings. Further refinements in emissions estimates may be possible by incorporating some of the aforementioned elements that are missing in the current survey: household-level vehicle use, whether respondents are driving to park-and-ride lots or transit stops, and possibly the incorporation of additional questions on vehicle type, vehicle refueling, and trip time of day. Clarification regarding what 'round trips' are should be made when the survey is given. The survey should also be implemented during the episode day if possible. Incorporation of questions to determine unprompted behavioral changes could eliminate some bias inherent in the current survey.

Area Source Activities: Most of the program's data collection efforts have been targeted at reducing travel-related behaviors that reduce emissions. One question included in the annual Transportation and Air Quality survey, however, does give some indication about whether people are changing other behaviors that would contribute to area source emissions. The question asks whether, on days on which unhealthy air is forecast, the respondent or anyone in their household refrains from using:

- Gas-powered garden tools
- Barbecuing on outdoor grills
- Aerosol products

[1] Trip end and length emissions were taken from SACOG ISTEA Guidance, Table 3, Average Emission Factors, 1995–1999.

In 1995, 50% of the public responded that they refrained from using gas-powered garden tools compared to 49% who refrained from barbecuing on outdoor grills, and 0.3% who stopped using aerosol products. These questions are currently asked in the end-of-the-year survey and are not included in the Spare the Air minipolls. It may be possible to increase the accuracy of the data by including these questions in the minipolls.

Stationary source activities: The Sacramento program does not have a stationary source element in its Spare the Air program so no stationary source data are collected.

Forecasting Abilities

In 1996 Sacramento contracted the weather and pollution episode forecasting responsibilities to Sonoma Technology, a private forecasting firm. Sonoma Technology worked with the AQMD and the California Air Resources board to develop a forecasting methodology which looks at ozone concentrations, winds, temperatures, satellite images, and forecast weather maps. From an analysis of these indicators Sonoma Technology estimates the ozone concentration predicted for the next day and the corresponding PSI value. Pollution forecasts are made at two times during the day, 11 a.m. and 3 p.m.

To help examine the accuracy of forecasting method used in Sacramento, data for the summer of 1995 were analyzed. The SMAQMD was contacted to obtain information on which monitoring sites are used to determine ozone exceedances. In addition, dates for which forecasting models predicted unhealthy air were also obtained. Model forecasts of ozone concentrations in excess of 90 ppb in the Sacramento area were made for 27 days during the summer of 1995. As seen in Figure 3-2, ozone exceedances (of the State Standard of 90 ppb) were observed on 22 of the forecast days. In addition, the ozone concentrations on 26 other days were also in exceedance of the ozone standard, and one day had a concentration equal to 90 ppb. Ozone exceedance information was based on the ozone concentrations of eight air quality sites within the Sacramento area.

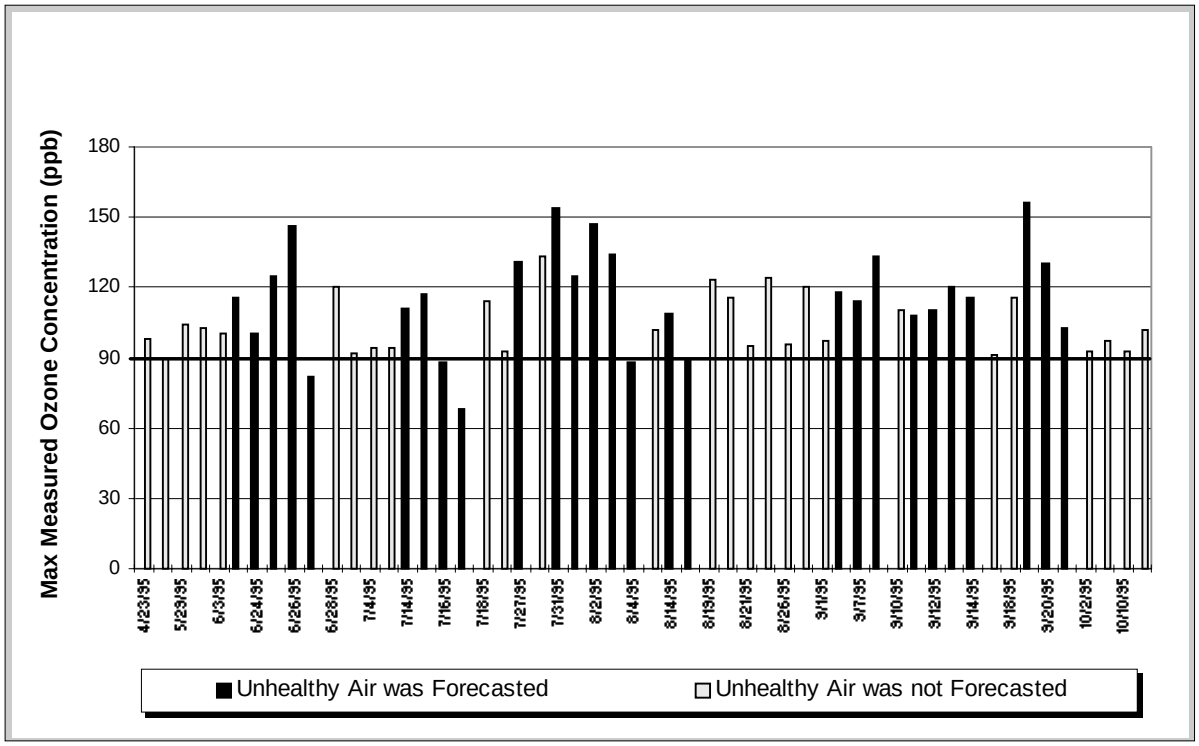


FIGURE 3-2. Forecasting accuracy in 1995.

During the 1996 ozone season, the district experienced 8 pollution episodes ranging from 2 to 11 days in length. In total, 40 days out of the 184-day Spare the Air season (May–October) were declared Spare the Air days. Comparing the predicted PSI values versus actual PSI values for the season shows that the forecasters regularly predicted pollutant levels higher than were actually recorded. On some days as many as three predictions were made during a forecasting period. Looking at the first predictions shows that false positive situations (Alert called/no exceedance measured) occurred on 31 of the 40 Spare the Air Days called. It is not known whether this is a result of flaws in the forecasting methodology, significant unexpected emission reductions from the program's control measures, or a general tendency on the part of the forecaster to err in the positive direction by intentionally estimating high. Perhaps because of a tendency to predict high values, no false negative (No Alert called/exceedance) predictions occurred. Lower than actual PSI values were predicted on nine Spare the Air Days. While the PSI comparison shows frequent differences between the predicted and actual pollution levels, a comparison of the actual measured pollution concentrations is perhaps more revealing. Overall, a comparison of the differences in forecast and observed maximum ozone concentrations by SMAQMD shows a relatively high degree of forecasting accuracy. Eighty-six percent of the forecasts were within 0.02 ppm of the measured ozone concentration.

DATA ON INDIRECT MEASURES

Indicators of Regional Travel Levels

The Sacramento program has obtained additional data from several state agencies to try to corroborate the findings from their survey data. The following are the types of data which have either been analyzed or are currently being investigated:

Transit Data: Weekly bus ridership and fare data were obtained from the Sacramento Regional Transit District for the 1995 season. Light rail data were not available for evaluation. Analysis of the bus data by the Cleaner Air Partnership of Sacramento showed that overall ridership levels did not increase on Spare the Air days compared to regular days. The analysis did show, however, that on Spare the Air days a greater percentage of riders paid with cash (as opposed to using a monthly pass) than normally. CAP analysts think this may be an indication that more people who normally drive are using buses on Spare the Air days. CAP is making efforts to obtain daily transit data for a more detailed analysis of this data.

Traffic Count Data: State highway traffic count data has been obtained from the California Department of Transportation. A comparison of the 1995 data on normal days and on Spare the Air days by SMAQMD revealed that there were no noticeable changes in the traffic flow on freeways on Spare the Air days. SMAQMD indicated that there is a fairly high degree of natural variation in the freeway traffic flow and that any reductions in flow caused by the Spare the Air program are not great enough to be observed. Variation in flow might be controlled for in a future study if enough resources were made available to analyze several years of traffic flow data. SMAQMD analysts report, however, that even if traffic flow changes were observed it would be difficult to attribute any of these to the Spare the Air program because of the large number of other variables which could be causing the changes. CAP analysis reported that they are not surprised that no changes are observed in freeway travel

since the survey data show that few of the trips that are reduced on Spare the Air days are freeway trips. A more revealing study might be to look at traffic count data on local streets to see if there is any observed changes in flows. SMAQMD has considered looking at local street traffic flows but is discouraged by the amount of resources it would take to analyze the large amounts of data.

Parking Count Data: A preliminary analysis of the number of receipts and total revenues from public parking lots in Sacramento did not show any significant changes on Spare the Air days. As with the traffic count data, SMAQMD reports that there is too much natural variability in the data to see any impact caused by the Spare the Air program.

4 SAN FRANCISCO BAY AREA—PROGRAM EVALUATION DATA

DESCRIPTION OF PROGRAM AND IMPLEMENTING AGENCIES

The lead agency responsible for operating the Bay Area "Spare the Air" program is the Bay Area Air Quality Management District (BAAQMD). The BAAQMD operates the forecasting and notification for Spare the Air notification days, develops outreach and public education information, runs an employer program, and coordinates the activities of all other groups and agencies that assist with operation of the program. The BAAQMD operated the Spare the Air Day program with a budget of $325,000 in 1996 with additional funds for this year's pilot program and special advertising. In addition to collecting data on the accuracy of the forecasting team, the BAAQMD has conducted several surveys on public awareness and has recently conducted surveys on episode days to determine changes in behavior.

Other groups involved in the BAAQMD's Spare the Air program include Community Focus, the Bay Area Clean Air Partnership (BayCAP), Smart Valley Inc., RIDES, the Santa Clara Valley Manufacturing Group, the Bay Area Council, Caltrans, and local transit agencies such as the Santa Clara Valley Transit Authority and CalTrain. Community Focus has been contracted by the BAAQMD to assist with the employer program as well as public outreach, media, and advertising. They have also performed a significant role is setting up air quality resource teams of civic, environmental, and business leaders in the community. Bimonthly meetings with business partners are held to evaluate and assist resource teams which have offered additional support to the program. Partnerships have formed with companies such as PG&E and Kaiser Permanente, which include information concerning the Spare the Air program in newsletters they send out to their customers. The Kaiser partnership has been distinctively effective since, as a health organization, it can discuss the health implications of the program. Other participating businesses include Chevron (pump information), Clover dairy (on milk cartons), San Jose Mercury News (logo and announcements on Spare the Air days) and Lucky Stores (in store banners and messages).

BayCAP is a new and innovative public-private partnership containing the BAAQMD, the Bay Area Council, and the Santa Clara Valley Manufacturing Group. Two events led to the formation of BayCAP: the passage of a state law ending employer-based trip reduction programs and weather conditions during the summer of 1995 that caused the Bay Area to exceed federal air quality standards. In April 1995, the U.S. Environmental Protection Agency noted that the Bay Area had three or fewer exceedances of federal air quality standards for three years in a row and granted the region "attainment" status. Then two months later, hot summer conditions hit the Bay Area and 11 exceedances of the federal ozone standard were recorded. Acknowledging that the BAAQMD would have to develop new rules or methods to reduce air emissions, the business community convinced the district to hold off on a new regulation saying that employers would work with the district to enact voluntary measures. BayCAP was put together to generate creative solutions to the region's air quality problems and has formed eight action teams focusing on different aspects of quantification and reduction of regional emissions. Two of these action teams, the Telecommute Action Team and the Capture the Credit Team, are specifically focused on quantification of emission reductions.

Smart Valley, Inc. is part of the Telecommute Action Team that developed an e-mail/web page system to track telecommuters' participation on Spare the Air days as part of its telecommuting initiative. Smart Valley is an associate of local companies in the Silicon Valley working together to coordinate people and technology with projects that enhance the quality of life. The association, which sponsors and develops electronic projects in a variety of areas (computers and Internet for schools, electronic job connections, electronic voting) has conducted a number of studies on telecommuting in the Bay Area and is committed to accelerate the deployment of telecommuting throughout Silicon Valley.

BayCAP, the Santa Clara Valley Manufacturing Group, Caltrans and local transit agencies such as the Santa Clara Valley Transit Authority and CalTrain are all participating in a 1996 pilot project to quantify the impacts of the Spare the Air program on employees at nine companies in the Santa Clara Valley. Staff at all of these agencies are cooperating on this study, and the BAAQMD has a budget of $197,000 to fund the program. Most of this money is targeted for development of focused outreach material, free transit for employees in the nine companies on Spare the Air days, and development and completion of employee surveys, collection of parking lot data, and final analysis of all data collected.

A summary chart of available data for the Bay Area episodic control program is presented in Appendix A. The remaining sections of this chapter contain a more detailed discussion of these data. The discussion is focused on data directly associated with program components, such as survey and forecasting data, since the BAAQMD has not yet completed an analysis of regional data such as transit or air quality trends.

DATA ON DIRECT MEASURES

The Bay Area program operates with an extensive outreach and public education program which includes employer outreach, radio and newspaper advertising, training workshops and speaking engagements in the schools and the community, participation in transportation fairs, and electronic (e-mail and web site) and phone access to the public. The BAAQMD 1996 budget for outreach included $280,000 for BAAQMD efforts and $115,000 for a consultant. An additional $81,500 for advertising was jointly funded by a partnership between industry and government.

To evaluate the effectiveness of the advertising and outreach programs, the BAAQMD has conducted several surveys (1990, 1995, and 1996) and focus groups (1995). The 1990 study, which was given before the program was implemented in 1991, serves as a baseline with which to compare certain key questions that were replicated in the 1995 survey. The 1995 survey included 708 phone interviews between May 11 and June 1, 1995, fairly early in the Bay Area ozone season. Interviewees were called during the evening hours (5–9 p.m.) and on weekends (Saturday 10 a.m.–6 p.m., Sunday 2–9 p.m.). The 1995 survey was focused on public perception of air quality issues, BAAQMD programs (including Spare the Air, Don't Light Tonight, and the Smoking Vehicle program), and perceived effectiveness of the programs.

To more deeply investigate some of the issues raised in the survey, two focus groups were also conducted in late June 1995. The San Francisco focus group consisted of workers who commute to San Francisco from a variety of counties in the Bay Area. The San Jose group contained a cross-section of the general public from the south bay. Group participants were recruited using a screening questionnaire developed by the BAAQMD. The questions raised

in the focus groups centered around the public's perception and understanding of air quality messages and reactions/suggestions concerning BAAQMD outreach material.

While the 1990 and 1995 data collection efforts were focused on determining the effectiveness of the BAAQMD's public outreach program, the 1996 episode-day phone surveys were aimed at determining changes in the public's behavior. The first episode survey was given on August 13, between the hours of 5:00 p.m. and 9:00 p.m. with a randomly selected group of 412 Bay Area residents over the age of 18. Spare the Air days had been previously announced for five days in a row from August 9 through August 13. By surveying the general public on Spare the Air days, the BAAQMD hoped to more accurately gauge the public's actions on the Spare the Air days. The surveys were carefully worded to include questions regarding changes in behavior concerning driving, use of consumer products, and gasoline-powered garden tools before mentioning the Spare the Air day program.

In 1996, in addition to distribution of normal outreach material, the Santa Clara Pilot program employer participants received special outreach materials, free transit on Spare the Air days, and workshops throughout the summer. Employers committed to survey employees to determine employee reaction and changes in behavior. Monitoring included measuring changes in traffic counts to flesh out changes related to Spare the Air day impacts. The survey results from this program should be available by the beginning of December and will be included in this report at that time.

Other efforts that the BAAQMD pursued during the 1996 summer season include collection of telecommute data on the Internet. The telecommute Internet site includes direct estimates of miles eliminated due to implementation of the Spare the Air program. Participants joined the program by registering with the web page and submitting information such as round trip miles included in commute. Once registered, participants are notified via e-mail once Spare the Air days are forecast. The following day participants were asked to fill in a survey indicating whether they stayed home or drove to work. If they did not telecommute, the participants were asked to respond why they did not telecommute.

Transit data collected during Spare the Air days indicate potential changes in behavior. Examination of transit data collected in the 1996 summer program will be completed in early December.

Participation Levels

The BAAQMD program includes 638 employer participants and estimates that approximately half a million people are notified of Spare the Air days through employer outreach. In the summer of 1996, the BAAQMD is conducting a pilot program with nine companies in the Santa Clara Valley to more fully quantify some of the impacts of the program.

Public Awareness of Program

In surveys conducted in 1990, 1995, and most recently in 1996, respondents were asked if they had heard of the slogan "Spare the Air" and what the slogan meant. In the 1996 Spare the Air-day surveys,

- 67% indicated that they had heard or seen the slogan "Spare the Air."

Of those who had heard or seen the slogan:

- 57% indicated that they knew that today was a Spare the Air day, and
- 61% indicated that they knew the purpose of a Spare the Air day.

Respondents were also asked what actions should be reduced or limited on Spare the Air days. Their responses are shown in Figure 4-1 below. It is interesting to notice the diversity of answers given by the respondents.

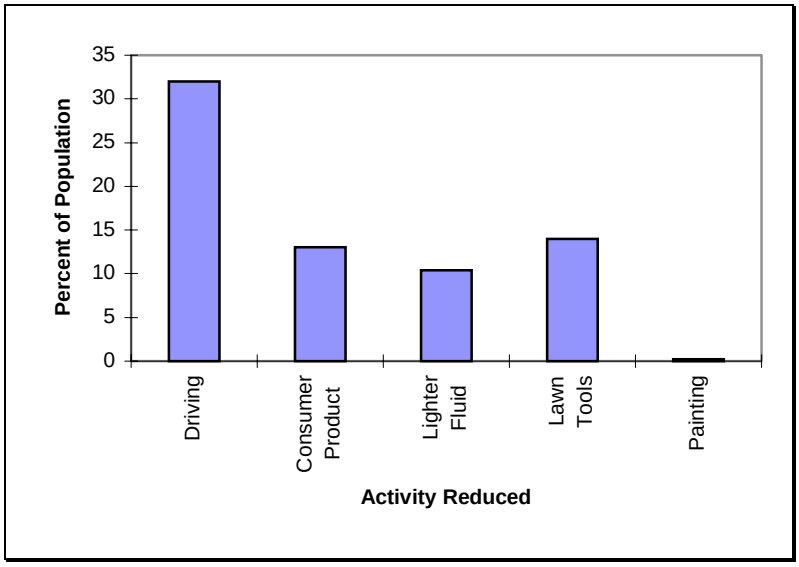


FIGURE 4-1. Respondents' understanding of program requirements.

The May 1995 ozone season telephone study specifically asked:

Have you seen or heard any air quality slogans?
What does "Spare the Air" mean?
Where did you hear the slogan "Spare the Air"?

Twenty-four percent of the survey respondents were aware of the slogan; of those respondents, 40% indicated that the slogan meant to "preserve the air" and 37% to reduce air pollution. However, 43% of these respondents also indicated that the program concerned not driving or using alternatives to driving, which translated to 10% of all survey participants. Of those who were familiar with the slogan, most indicated that they had heard of the program from other sources than those listed in the questionnaire (radio, TV, employer, friend/relative) or couldn't recall; however, 26% and 24% indicated that radio and TV were likely.

Focus groups offer a way to research more qualitative information such as individuals' understanding and perceptions of issues and motivations for changes in behavior. While the size of a focus group limits the extrapolation of results to the entire Bay Area population, analysis of the results can indicate potential trends in the general public's understanding. In addition to the questions included in the phone survey regarding the "Spare the Air" slogan, the participants in the focus groups were asked what type of media coverage, additional in-

formation, or employer recognition would be likely to influence their behavior. The groups were also asked about the effectiveness of the Spare the Air day slogan and their reactions to a brochure.

Most participants in the focus groups indicated that they had heard the slogan on television and responded with some of the following responses regarding the meaning of the slogan which indicated that they understood the meaning of the program[1]:

- Don't drive, burn or use aerosol hair spray
- Don't use lawnmowers
- Don't use your barbecue today, not all the time, just today, don't cut your lawn
- Minimize the use of your car
- Don't use those leaf blower things, I think those are gasoline powered

It is interesting to note; however, that when asked about their behavior, only a small number of the participants indicated that they would be willing to curtail auto trips on Spare the Air days, a far greater percentage were willing to curtail use of consumer products and gasoline powered garden equipment. Participants also indicated that use of multiple media sources and inclusion of health effects information would be positive for influencing behavior. When asked about the "Spare the Air" slogan, even though most seemed to understand the scope of the program, participants thought that a slogan more specific or serious would be more effective.

Public Perception of Air Quality Problem

The 1990 and 1995 surveys included a significant number of questions regarding the public's perception of air quality issues. Questions ranged from the priority of air quality issues to the impact of cold starts. The questions included in the surveys are listed below:

Please rank the following public policy issues (issues differ somewhat in two surveys)

How serious is air pollution in the Bay Area (very, somewhat, not very or not at all)?

Has air pollution changed over the past five years (gotten worse, stayed the same, gotten better)?

If air pollution has gotten worse, why?

How is air pollution impacting people's health (very, somewhat, not very, not at all, don't know)?

What are possible solutions to air quality problems?

Are cold or hot starts more polluting?

Overall, a comparison of the results from the two years indicate that respondents perceive that air pollution is less serious issue than five years ago (which could reflect the fact the concentrations are generally lower); however, they are more aware of air quality levels and solutions to air quality problems. For example, when asked about cold starts, in 1995, 53% indicated that they believe cold starts cause more pollution than warms starts. In comparison, in 1990, 46% believed that cold starts are more polluting. The general population

[1] It is possible that the magnitude of this positive response was influenced by the fact that an alert day was called preceding the scheduling of the focus groups. Thus indicating that the outreach and notification during these days was effective.

seems to been tuned in to improved air quality concentrations and the appropriateness of certain actions.

Changes in Emission Producing Activities

Travel Related Activities

Since the 1996 surveys were completed on announced episode days, these results offer the most accurate picture of changes in behavior which have in impact on emissions. The questions were phrased to eliminate any bias as to the "preferred answer." The episode day survey began with the following three questions:

> In the past 2 days, did you drive your car or truck less frequently than you normally do? (yes, no, don't own car/truck)
>
> If yes, What did you do instead of driving? (eliminate trip, carpool, use transit, walk...)
>
> Why did you make that change? (air quality related, other reason, both, don't know)

Due to the shortage of Spare the Air days forecast by the BAAQMD during the summer of 1996, only two surveys, one in August and another in October, were completed. The first survey was administered in the evening of August 13 after a series of well-publicized Spare the Air days. The highest ozone readings of the year were recorded during this episode. Twenty-five percent of the 412 respondents in the August survey indicated that they "drove less in the past two days," with 11% of these saying that they did so for "air quality related" reasons. Overall this represents 4% of those interviewed.

The second survey was conducted on a Monday evening, October 7. Employer participants were not notified of Monday announcements and the media was not as well focused on the story on this day. As a result, the responses were not as good as the first survey. There was no indication that respondents curtailed driving for air quality reasons, although 17% indicated that they had limited the use of consumer products with 22% of those citing air quality reasons.

As mentioned previously the Smart Valley telecommute web page includes direct estimates of miles of driving eliminated due to implementation of the *Spare the Air* program. The results of the responses from approximately 200 people are shown in Table 4-1.

TABLE 4-1. Participation in telecommute program (number of participants / miles eliminated).

Date	Telecommute	Public Transit	Carpool	Vanpool	Walk	Bike	Total
7/30/96	14 / 418	8 / 538	6 / 120	0 / 0	0 / 0	5 / 82	33 / 1158
8/9/96	18 / 740	3 / 100	7 / 214	0 / 0	0 / 0	3 / 18	31 / 1072
8/12/96	17 / 552	5 / 240	7 / 208	1 / 80	1 / 8	3 / 16	34 / 1576
8/13/96	17 / 776	8 / 400	8 / 302	1 / 80	1 / 8	3 / 18	38 / 1576
8/29/96	25 / 1288	11 / 668	3 / 76	1 / 80	1 / 8	5 / 112	46 / 2196
9/9/96	16 / 754	5 / 314	2 / 52	1 / 80	0 / 0	4 / 180	28 / 1238
10/8/96	21 / 996	12 / 608	9 / 324	1 / 80	2 / 36	11 / 276	56 / 2116

The web page also indicates why the remaining participants in the program stated that they could not telecommute. The most frequent response, at 41%, was to attend meetings. Twenty-three respondents stated that they did not hear about the Spare the Air day, and another 20% needed to drive to work to use their computer. Seven percent were on vacation, 6% were not permitted to telecommute, and the remaining 4% needed the car for work.

As previously mentioned, the BAAQMD is operating a pilot program in the Santa Clara Valley this summer to develop measures to quantify some of the impacts of the Spare the Air program. Free transit (CALTRAIN, SJ light rail, and buses) was offered to the employees of these companies on episode days. In addition, RIDES for Bay Area Commuters (bay area carpool program) also prenotified all employees of potential carpool partners before episode days so that they were prepared and knew who to call. In conjunction with these efforts, employers agreed to monitor traffic count at their entrances to monitor changes in driver behavior. Data collected during the pilot program will be available in early December.

Area Source Activities

The 1996 episode day surveys contained a number of questions related to reduction of activities associated with area emissions. The following questions were asked of respondents:

> Did you reduce your use of consumer products like hair spray, air fresheners, perfumes or insecticides in the past 2 days? (yes, no, don't normally use, don't know)
>
> Why did you reduce your use of that (those) products? (air quality related, other, both, don't know)
>
> Did you reduce your use of gas powered garden tools in the past 2 days? (yes, no, don't normally use, don't know)
>
> Why did you reduce your use of gas powered garden tools? (air quality related, other, both, don't know)

The survey, conducted on the evening of August 13, indicated that 21% of the respondents had reduced their use of consumer products like hair sprays, air fresheners, etc. Of these, 27% did so for "air quality related" reasons. This represents almost 11% of those surveyed. Nineteen percent also indicated that they had reduced use of gas-powered garden tools, and 30% of those did so for air quality reasons. It is notable that the survey indicates that respondents curtail activities like the use of consumer products and lawn and garden tools rather than curtail driving. The BAAQMD cites that 150 tons per day of organics are generated by motor vehicles, 50 tons per day are generated by consumer products, and 5 tons per day are from lawn and garden equipment. The BAAQMD indicates that programs such as their Spare the Air program can have more impact in reducing ozone levels if emphasis is expanded to include activities other than driving.

Forecasting Abilities

Forecasting periods of high ozone for the San Francisco Bay Area is the responsibility of the Meteorology and Data Analysis Section of Technical Services of the Bay Area Air Quality Management District. Forecasts are made based on the correlation of meteorological parameter and high ozone. Criteria for forecasting an episode day is a Pollution Standard Index (PSI) of greater than or equal to 80. This cutoff corresponds to the state standard of an ozone concentration of greater than 90 ppb. The input variables are surface winds, surface

temperature, horizontal temperature gradients, NGM, ETA, MRF model outputs, fog patterns, weekday/weekend influences, as well as ozone and ozone precursor measurements. Inputs for the forecast model are obtained from the National Weather Service, private companies, and from the District's own monitoring equipment.

To help examine the accuracy of forecasting method used in the Bay Area, data for the summer of 1995 was analyzed. The BAAQMD was contacted to obtain information on which monitoring sites are used to determine ozone exceedances. Dates for which forecasting models predicted unhealthy air were also obtained. During the 1995 ozone season, the District issued 24 Spare the Air Advisories. Model forecasts (made on day before) of ozone concentrations in excess of 90 ppb in the San Francisco area were made for 23 days. As seen in Figure 4-2, ozone exceedances (of the state standard of 90 ppb) were observed on 19 of the forecast days. In addition, the ozone concentrations were also in exceedance of the ozone standard on 9 other days. Of the original 24 forecast advisories, 4 days (28 July, 20 September, and 3–4 October) did not measure exceedances. Ozone exceedance information was based on the ozone concentrations of 24 air quality sites within the San Francisco area.

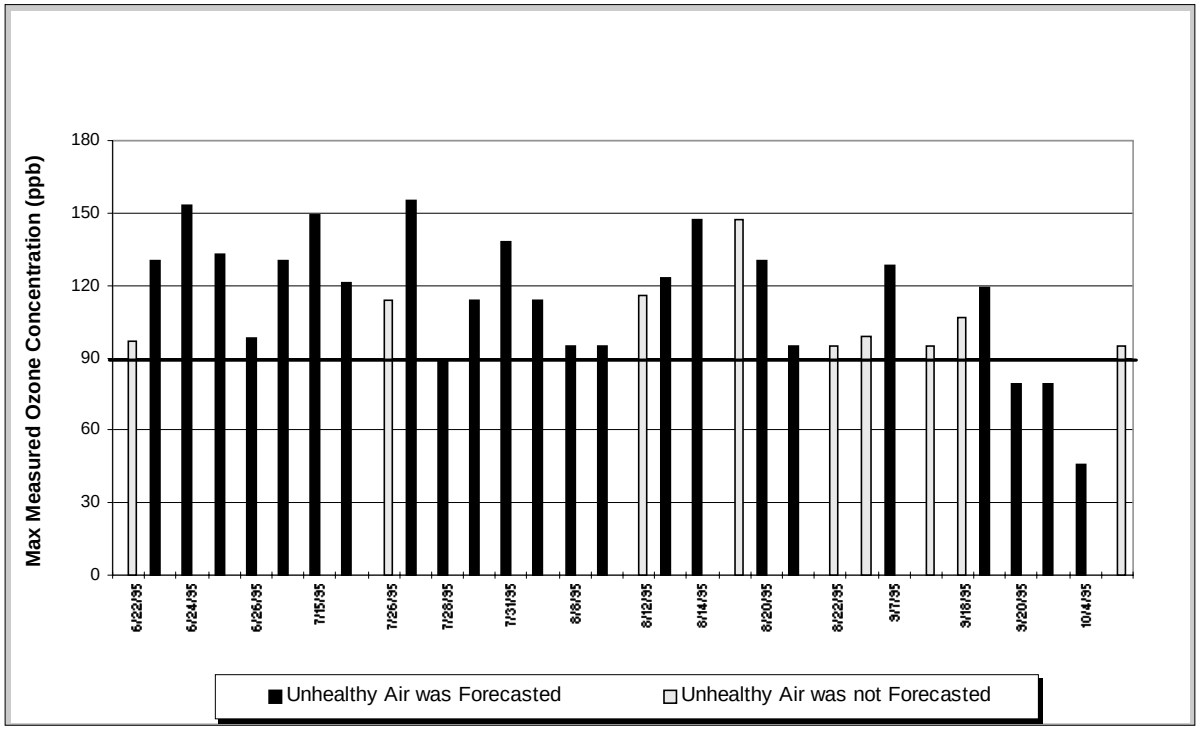


FIGURE 4-2. Forecasting accuracy for 1995.

DATA ON INDIRECT MEASURES

A review of the Bay Area Clean Air Partnership (BayCAP) Progress reports for 1996 and 1997 highlighted several initiatives either underway or that have potential to assist the program in obtaining indirect measures of their program's effectiveness.

Caltrans has briefed the program's Capture the Credit Team on highway monitoring technology such as embedded sensors, remote television, HOV programs, and the Transportation Management Center. These technologies may be available to help quantify changes in commute behavior and emission reductions.

The Capture the Credit Team identified over 1,000 alternatively fueled vehicles that operate in the Bay Area and estimate the emission reductions at over 5 tons of smog-forming pollutants.

The 1997 report highlights a case study of the EcoPass program, founded by the Santa Clara Valley Transportation Authority. EcoPass is a partnership among SCVTA and Silicon Valley companies to increase transit ridership among the local workforce. Companies can purchase EcoPasses at a deeply discounted rate. Each pass allows for unlimited travel on SCVTA bus and light rail seven days a week. In the first year pilot program, the number of employees using public transit to commute increased 55 percent. Currently, 19 companies and 43,000 employees are EcoPass holders. In 1998, BayCAP is working in partnership with SCVTA to plan an extensive promotional campaign to increase ridership at EcoPass companies, including promoting transit use on *Spare the Air* days.

A World Wide Web page was created to advertise the program and allow users to register for *Spare the Air* alert notifications. The 1996 report states that 300 people registered to telecommute, thereby eliminating 5,000 miles of driving on weekday *Spare the Air* days. Others chose other commute modes, such as public transportation, carpool, vanpool, walking, or bicycling, eliminating an additional 5,000 miles. The 1997 report stated that on August 6 (one of three *Spare the Air* days), 1,619 participants were notified, and surveys showed that 25 percent changed their commute behavior. BayCAP estimates that on that day approximately 9,000 vehicle miles were saved, and 17 pounds of reactive organic gases (ROG) and 20 pounds of nitrogen oxides (NOx) were eliminated from the air. While these are constitute direct measures, this technique is an interesting use of the Internet to selectively work with and understand a growing subset of the program's target audience. While cost information was not provided, the use of the Internet to reach this target audience is most likely much less expensive than traditional survey approaches and provides an opportunity for more timely responses.

5 CINCINNATI — PROGRAM EVALUATION DATA

DESCRIPTION OF PROGRAM AND IMPLEMENTING AGENCIES

The Cincinnati Program has been in operation since July 1994 and is managed by the Ohio-Kentucky-Indiana (OKI) Council of Regional Governments. Because this group is the MPO for Cincinnati, it has been very successful in obtaining CMAQ funding to help grow the program. The Regional Ozone Coalition is well organized and has creative partnerships to assist in meeting the program goals. As with most programs, the coalition is finding it difficult to share program responsibilities evenly among partner organizations. Of significant interest is that $986,000 is budgeted over three years for the episodic control program and another $1.875 million is budgeted over three years to subsidize the fare reduction program. This is the most well-funded program by far of the programs in our analysis.

During the summer of 1994, a Regional Ozone Coalition formed in response to a threatening number of exceedences at monitoring sites throughout Greater Cincinnati/Northern Kentucky. This unprecedented regional effort included businesses, legislators, regulators, and transportation providers. An emergency public awareness campaign was launched with a clear message: voluntary initiatives that individuals and businesses take now might save the region from mandatory requirements later. The campaign, *Do Your Fair Share for Cleaner Air*, raised public awareness and provided remedies that individuals could practice to reduce the potential for ground-level ozone formation. The region finished the summer without an ozone violation and petitioned the U.S. EPA for reclassification to an ozone attainment area.

In 1995, the Regional Ozone Coalition prepared for an intensive effort to try to avoid additional smog exceedences and assure their chance at achieving attainment. Smog alerts were called by the Hamilton County Department of Environmental Services the afternoon before an anticipated high-ozone day to trigger individuals and businesses to take low-cost, voluntary steps to reduce ozone-producing activities. This was supported by a multimedia marketing campaign and emergency business notification system. The fare on Metro buses was reduced to 25 cents on most alert days, resulting in an increase of up to 18% in ridership or more than 7,000 additional riders. The summer of 1995 finished with 17 smog alert days and 9 exceedences, resulting in one violation of the ozone standard. Only one of the exceedences was not during a smog alert. The program received an Ohio Governor's Award for Outstanding Achievement in Pollution Prevention.

In 1996, the Regional Ozone Council continued the effort to avoid additional ozone exceedances and assure their chance of obtaining an extension for attainment. Smog alerts were again called the afternoon before an anticipated high-ozone day. "The Do Your Fair Share For Cleaner Air" multimedia marketing campaign was expanded to include many special events around the region and a children's newsletter. The emergency business notification system again notified nearly 1,000 businesses of the smog alerts. The fare on Metro buses was reduced to 50 cents for the entire summer. The summer of 1996 finished with 11 smog alert days and 3 exceedences, of which only one was not during a smog alert.

The available data for the Cincinnati episodic control program are summarized in Appendix A. The remainder of this chapter contains a more detailed discussion of those data. The discussion is divided into two sections, Direct Measures, consisting of survey and forecasting data, and Indirect Measures, summarizing regional transit data.

DATA ON DIRECT MEASURES

Surveys were conducted in 1994, 1995, and 1996 to determine the success of public outreach and to elucidate improvements for the next year's effort. At the close of 1994, a public survey of 1,500 residents of the seven-county region was taken to gauge public attitudes toward the ozone problem. In addition to questions targeting attitudes, the survey had questions focusing on public familiarity with the "Do Your Share For Cleaner Air" campaign and whether people had changed their daily habits when ozone alerts were called. In 1995, phone surveys were conducted before and after the campaign to determine the success of the 1995 outreach campaign. The 1995 survey focused on many of the same issues as the 1994 survey, and the results included subgroups that allowed examination of results by age group and by county. Business participants were also surveyed in 1995 to determine the extent of employee participation and to determine if the outreach material provided by the program was adequate. In 1996, additional phone surveys were completed using the same questions as in 1995.

Public Perception of Air Quality Problem

The 1994–1996 surveys included questions regarding the public's perception of air quality issues, ranging from the seriousness of air quality problems to tests of the public's understanding of air pollution. Some of these survey questions are listed below:

> How would you rate the seriousness of our smog problem on a scale of one to five? (1 = not very serious, 5 = extremely serious) (1-5)
>
> Please tell me how much you think smog affects the public's health on a scale of one to five? (1 = not very significant, 5 = extremely significant) (1-5)
>
> How much do you think smog affects jobs and businesses in our area, on a scale of one to five? (1 = not very much effect, 5 = significant effect) (1-5)

The 1994 survey indicated that 73% of those surveyed felt that air quality was average to very bad; 80% thought that smog had a significant to extremely significant affect on the public's health. In comparison, early in 1995, the survey indicated that approximately 75% felt that air quality was average to very bad; however, at the end of the season, that percent had increased to over 80% with most of the increases occurring in the bad and very bad responses. With regard to impacts on public health, the precampaign survey indicated that over 80% thought that smog had a significant to extremely significant affect on the public's health. By the end of the ozone season, that number had risen to over 85% with the largest increase in the "extremely significant effect" response.

The surveys also tried to determine if the public understood the contributors to smog and what they could do to improve air quality. Questions focused on public understanding are listed below.

> Please tell me what things you think cause the most smog in Cincinnati. (Do not prompt. If only one thing given, ask, anything else? X as many as given)

- Trucks
- Construction
- Automobiles
- Factories/Industry
- Lawn equipment
- Airplanes/airport
- Other, describe:

Please tell me the things you think a resident of greater Cincinnati or northern Kentucky could do to keep smog out of the air? (Do not prompt; if only one thing is given, ask Anything else? X as many as given)

- Take the bus instead of driving
- Ride bike or walk instead of driving
- Carpooling
- Cut lawn or use lawn equipment after 6 pm
- Conserve electricity
- Avoid use of paints or stains
- Avoid filling gas tank until after 6 pm
- Keep car tuned up and maintained
- Don't use aerosol cans
- Other, describe:

In 1994, results from the survey indicated that 40% of those surveyed felt that industry was the largest contributor to the smog problem while 45% felt that cars and trucks were the greatest contributors. The precampaign survey in 1995 showed similar responses to the 1994 survey; however by the end of the season, those concerned with industry impacts had dropped to 28% while those concerned with the contributions of cars and trucks had increased to 46%. The most popular actions suggested by respondents included carpooling, taking the bus, and tuning up the car. At the beginning of the season, various miscellaneous responses constituted 40% of the responses; however, by the end of the season, the number of people suggesting carpooling was greater (29%) than the number of miscellaneous responses (28%).

Public Awareness of Program

The surveys completed each year included one question concerning the public's awareness of the "Do Your Share for Cleaner Air" program. The following question was included in the 1994, 1995, and 1996 surveys:

Are you familiar with Cincinnati's smog problem or the Smog Alert program? (Y/N/U)

If yes, where did you hear about it?

- Radio
- TV
- Newspaper
- Flyers
- Billboard
- Employer

If answer to 6 was radio, TV, or newspaper, Was it an advertisement of a news story? (A = Advertisement, N = News story)

This question can be used to determine if people are hearing the message about the episodic program, and through what medium as well. Figure 5-1 shows changes in the public awareness of the "Do Your Share for Cleaner Air" program. Note that public awareness drops to similar levels at the start of each season and seems to increase to higher levels each year. The most dramatic results were found from the survey given in the spring of 1996, the survey indicated that about 17% knew about the program, but in the fall that number had increased to 65%. The surveys also indicate that the public is hearing about the program from TV (over 70%). The market share for all other media is below 20%.

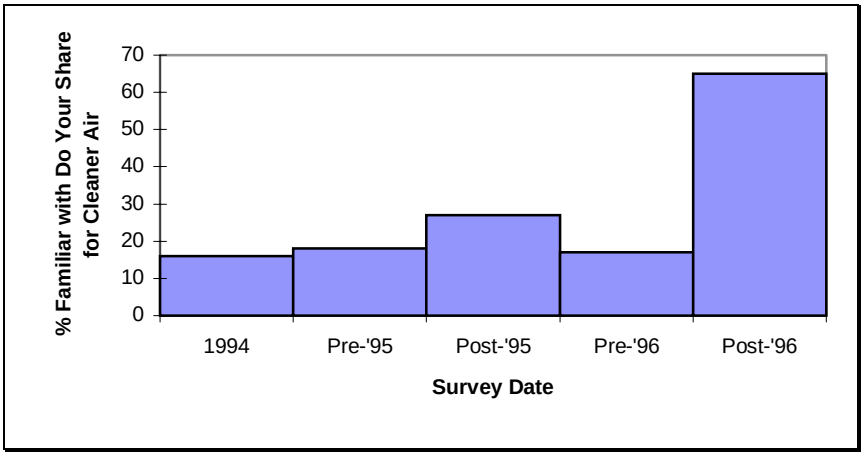


FIGURE 5-1. Trends in public awareness.

Participation Levels

There are 1200 local businesses participating in the Cincinnati "Do Your Share for Cleaner Air" program. OKI uses a fax tree service out of San Francisco to alert all 1200 businesses at the same time. In 1995, OKI conducted a survey of these participants which included questions concerning operations during alert days and materials the business received to assist with the program. Fourteen percent of the businesses responded to the survey, of whom 92.2% replied that they promptly notify their employees on alert days. Table 5-1 indicates the responses to a question concerning the number of employees.

TABLE 5-1. Potential number of participants.

Employees	Companies	Percent of Total	Potential Employees
1-49	25	23.4%	625
50-99	16	15.0%	1,200
100-199	13	12.1%	1,950
200-299	10	9.3%	2,500
300-399	6	5.6%	2,100
400-499	2	1.9%	900
500-599	18	16.8%	9,900
1000-1499	6	5.6%	7,500
1500-1999	2	1.9%	3,500
2000-2999	3	2.8%	7,500
>3000	6	5.6%	21,000
		Total	**58,675**

The last column of Table 5-1 indicates that at least 58,675 employees receive information about the alert day program at their place of employment. This estimate is probably low since only 14% of the companies participating in the program replied to the employer survey.

The results of the 1995 employer/business survey can also be used to determine if the business outreach efforts of OKI were effective. Examples of these types of questions are included below.

> Did you request materials (tip sheets, posters) from the Regional Ozone Coalition? (yes,no)
>
> If you received a Smog Alert banner, did it become damaged? Did the paint peel or crack? (yes, no, n/a)
>
> Did the banner fit your needs (eg. size, usability)? (yes, no, n/a)
>
> Would your company take advantage of an informational presentation to employees if available? (yes, no, maybe)
>
> Do you feel the information distributed by the Coalition was useful, timely and informative? (yes, no)
>
> Is there anything else you would like us to know?

In addition to the yes/no replies, blank lines were included for respondents to reply to the individual questions. A considerable amount of useful information was gathered in the survey. On the whole, many respondents felt that the Coalition should begin its information campaign earlier in the year since they felt rushed into the program. A few respondents were unaware of the availability of some materials, and almost half expressed interest in having a presentation. Some complained that the Smog Alert faxes were received too late in the day (especially on Fridays).

Changes in Emission Producing Activities

The Regional Ozone Coalition has attempted to measure public response to the Smog Alert program by including several questions regarding individual changes in daily habits. The questions ask respondents to recall their behavior during alert days over the past summer. The questions and examples of the possible unprompted responses are listed below.

> This summer, officials in our area called a smog alert on some days and asked the public to avoid doing certain things that cause smog. Did you change any of your habits when these alert days were called? (Y/N/U) ___
>
> If yes, Please tell me what you changes or did differently as a result of poor air quality and smog alert days. (Do not prompt; X all that apply)
>
> - Took the bus instead of driving
> - Did the 50-cent fare rate influence your decision to take the bus? (Y/N) ___
> - Rode bike instead of driving
> - Carpooled
> - Cut lawn or used lawn equipment after 6 p.m.
> - Saved electricity
> - Avoided use of paints and stains
> - Avoided filling gas tank until after 6 p.m.
> - Kept car tuned up/maintained
> - Didn't use aerosol cans
> - Other; describe:
>
> Suppose you heard about a smog alert tomorrow. Would you make any changes in your daily habits? (Y/N)
>
> If no, Why not?

If yes, what changes would you make?

- Take the bus instead of driving
- Ride bike or walk instead of driving
- Carpool
- Cut lawn or use lawn equipment after 6 p.m.
- Conserve electricity
- Avoid use of paints and stains
- Avoided filling gas tank until after 6 p.m.
- Keep car tuned up and maintained
- Don't use aerosol cans
- Other; describe:

In 1994 and at the beginning of 1995, approximately 18% of the respondents answered that they had changed their daily habits when ozone alerts were called. By the end of the 1995 ozone season, the percentage reporting changes in behavior had increased to 50%. In the early surveys, the most popular activities taken in response to the alert day included mowing after 6 p.m. (21%) and saving electricity (20%). In comparison, most popular responses in the later survey were mowing after 6 p.m. (41%) and filling up after 6 p.m. (27%). With regard to willingness for future Smog Alert day activities, in the pre-1995 survey, approximately 90% stated that they would save electricity or avoid topping off. In the postcampaign survey, these responses dropped slightly; however, those willing to mow after 6 p.m. (78–80%) and fill up after six (70–76%) increased.

The employer survey conducted in 1995 also contained some questions concerning the participants' response to the alert program. The survey included two questions asking about employee and company responses. The first question asked the opinion of the respondent (most likely a business contact) regarding the degree to which employees participated in voluntary activities recommended by the program (carpool, ride the bus, operate gas-powered equipment after 6 p.m.). Approximately 50% responded that they thought that employees participated "somewhat" and 25% responded that they "didn't know." With regard to company activities, the following responses were received:

Notified employees of Smog Alerts—84 %
Distributed "tip sheets" to employees—53%
Postponed operation of gas-powered equipment—41%
Reduced electricity consumption—31%
Refueled fleet vehicles at night—30%
Allowed flex time—25%

As appropriate, the Regional Ozone Coalition has not attempted to take these estimates of behavioral changes and calculate emission estimates. As can be seen by the differences in the surveyed behavioral changes discussed above, it is difficult to estimate the public's actual response to the alert program, especially on a specific alert day and calculate the corresponding changes in emissions.[1] However, the data reported by these surveys is still quite useful for understanding the effectiveness of many parts of the episodic program. Responses concerning the public's willingness to participate in certain activities, for example, indicate the public's understanding of air quality issues and their willingness (under the right circumstances) to participate in the program.

[1] Estimates of emission changes associated with increased transit ridership have been determined and are discussed in the section on indirect data.

Forecasting Abilities

Forecasting of ozone concentrations for the "Do Your Share For Cleaner Air" is done by meteorologists working for the local television stations as well as employees of the Hamilton County Department of Environment Services. Once a forecast of high ozone concentrations is made, a fax tree service out of San Francisco (which has the ability to fax out information to all participants simultaneously) is employed to notify the 1200 local businesses participating in the program. Alerts are also mentioned in television news and weather reports. Special announcements are also made via radio broadcasts, and alert status information is given in local newspapers.

In 1995, smog alerts were called the afternoon before forecast high-ozone days by the Hamilton County Department of Environment Services. By calling these alerts it was hoped that businesses and individuals would take voluntary steps to reduce activities having the potential to increase ozone concentrations. Incentives, such as 25 cent bus fares on alert days, resulted in an increase of up to 18% in ridership. In 1996, smog alerts were again called on the afternoon before days forecast to have high ozone. During this summer, bus fares were reduced to 50 cents for the entire summer. Eleven smog alert days were called. Three exceedances were recorded, one of which was not on a day on which a smog alert was issued.

Ozone data for the summer of 1995 were analyzed to help examine the accuracy of forecasting method used in Cincinnati. Robin Smith of OKI Regional Council of Governments was contacted to obtain information on which monitoring sites are typically used to determine ozone exceedances. In addition, dates for which forecasting models predicted unhealthy air during 1995 and 1996 were obtained. Model forecasts (those made for the same day as well as for one and two days in advance) of ozone concentrations in excess of 125 ppb in the Cincinnati area were made for 19 days during the summer of 1995. As seen in Figure 5-2, ozone exceedances (of the federal standard of 125 ppb) were observed on each of the forecast days. One additional exceedance of the ozone standard was measured during this period. Ozone exceedance information was based on the ozone concentrations of 10 air quality sites in the Cincinnati area.

DATA ON INDIRECT MEASURES

Two parallel programs operated in the area. A transit fare reduction program was funded through CMAQ for $700,000 per year. The transit agency noticed that ridership rates were much higher (+18%) when it continued the fare reduction throughout the entire summer (not just during episodic days) and that ridership kept up into the fall. Fares were 0.25 on smog days when the program was first operated. Now the reduced fare is $0.50 on all days of the season (normal fares could be as much as $1.10). The Cinergy company pays up to $60 per employee per month for commute costs associated with transit or vanpool fees and takes advantage of the federal tax incentive. It has challenged other companies to do the same. In addition to stressing travel reductions for the employees, Cinergy asked business participants to reschedule fleet refueling and outdoor lawn maintenance.

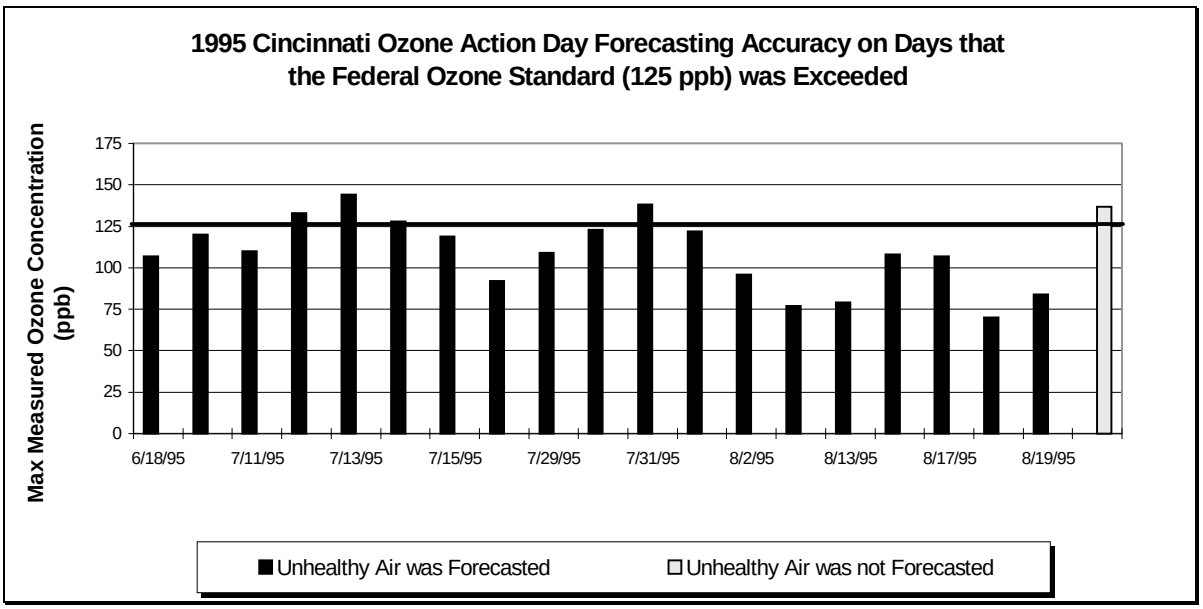


FIGURE 5-2. Forecasting accuracy in 1995.

Indicators of Regional Travel Levels

In the summer of 1994, the Southwest Ohio Regional Transit Authority (SORTA) provided bus service at a reduced fare of $0.50 between July 11 and September 5. SORTA tracked ridership over the summer to determine if the Smog Alert program had any impact on transit ridership. From these data, SORTA has determined that operating with reduced fares over the summer of 1994 resulted in [2]:

Just under 500,000 additional passenger trips.
2.1 million fewer vehicle miles traveled (VMT)
7.35 fewer tons of hydrocarbons emitted (HC)
39.95 fewer tons of carbon monoxide (CO), and
4.74 fewer tons of nitrogen oxides (NOx)

SORTA incurred costs[3] which were associated with the reduced fare. These additional costs included:

836 additional operating hours
$102,300 in operating and marketing costs
$457,000 in lost revenue

A summary of the analysis completed by SORTA is shown in Table 5-2. The analysis indicates that the program is most cost-effective for reducing carbon monoxide (CO) at $14,000 per ton of CO reduced. Costs for hydrocarbons (HC) and nitrogen oxides (NO_x) are substantially higher at $76,095 and $117,996 per ton of pollutant removed.

[2] Data provided to ICF by SORTA; no data were provided on assumptions used in the analysis.
[3] Data provided to ICF by SORTA, no data provided on assumptions used in the analysis

TABLE 5-2. Changes in transit due to impacts of smog alert program.

	Ridership	VMT	HC (tons)	CO (tons)	NOx (tons)
Change	~500,000	2,100,000	7.35	39.95	4.74
$/per	1.12	0.27	76,095	14,000	117,996

In the summer of 1995, SORTA focused its reduced "clean air" fare on days that a smog alert was declared. SORTA budgeted 20 smog alert days at a reduced fare of $0.25 for the period between July 14 and Labor Day. Funding was not approved in time to provide the reduced fare service before July 14. During the July 14 – August 18 period, seven smog alert days were called, the impact of the reduced fare program indicated that[4]:

> Over the seven days, SORTA's weekly ridership increased by an average of 7,800 passengers per day, an average increase of 11 percent.
>
> On August 2, the second of two consecutive days of an alert, SORTA's daily ridership increased by 22 percent or 15,100 riders above the norm.
>
> 1.2 fewer tons of hydrocarbons (HC)
>
> 6.7 fewer tons of carbon monoxide (CO)
>
> 0.9 fewer tons of nitrogen oxides (NO_x)

SORTA's costs [5] associated with the reduced fare included:

> $30,000 in marketing and promotion costs & $205,000 in lost revenue

A summary of the 1995 analysis completed by SORTA is shown in Tables 5-3 and 5-4. Even though the costs of running the program in 1995 were lower (since low fares were restricted to alert days), the corresponding increases in ridership were much lower in 1995. Therefore the overall cost-effectiveness of the program (e.g., $35,074 per ton CO removed) were much more disappointing.

TABLE 5-3. Smog alert day ridership in 1995.

Date	Total rides	Increase	Percent increase
7/14/95	77000	9300	18%
7/31/95	69400	1700	3%
8/1/95	78200	10500	16%
8/2/95	82800	15100	22%
8/14/95	74700	7000	11%
8/17/95	73200	5500	9%
8/18/95	73000	5300	9%
Total	528300	54400	

Note: average ridership is 67,700 rides per day.

[4] Data provided to ICF by SORTA, no data provided on assumptions used in the analysis.
[5] Data provided to ICF by SORTA.

TABLE 5-4. Changes in transit due to impacts of smog alert program in 1995.

	Ridership	VMT	HC (tons)	CO (tons)	NOx (tons)
Change	54,400	228,480[6]	1.2	6.7	0.9
$/per	4.32	1.03	195,833	35,074	261,111

In 1996, the fare reduction program, marketed as the "Clearance Sale" was in effect every weekday[7] from June 1 through Labor Day, similar to the 1994 program. Consequently, the public response to this program was much like that recorded in 1994. Examination of ridership data by SORTA indicated that because of the program, Cincinnati experienced:

- 533,000 increased transit rides
- 2.6 million fewer vehicle miles traveled (VMT)
- 8.8 fewer tons of hydrocarbons (HC)
- 48 fewer tons of carbon monoxide (CO), and
- 5.7 fewer tons of nitrous oxides (NOx)

Figure 5-3 shows the change in ridership recorded in 1996. The lower line indicates the budgeted ridership projections made by SORTA and the upper line is the actual recorded ridership during the summer of 1996. SORTA's costs for operating this program were:

$580,000 in lost revenue

$45,000 in marketing and promotion costs

.

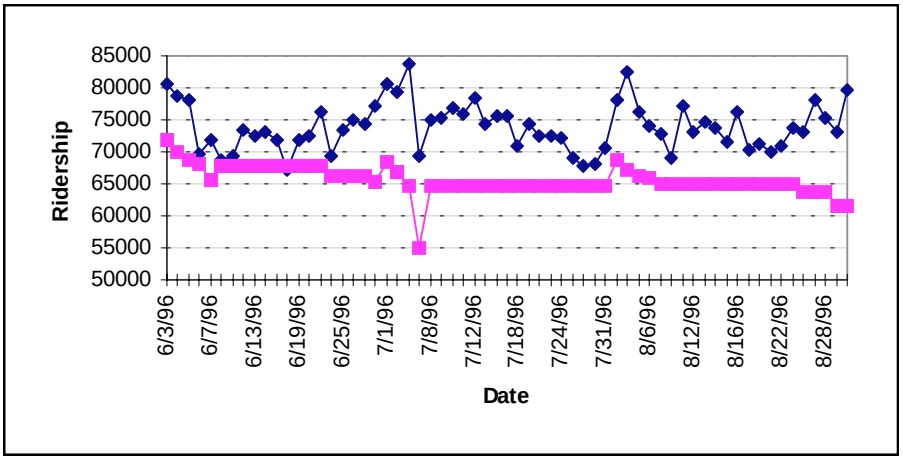


FIGURE 5-3. Changes in budgeted and actual ridership in 1996.

Table 5-5 summarizes SORTA's analysis of the overall impact of the program in 1996. The cost-effectiveness estimates for the program were similar to those measured in 1994. The cost-effectiveness of reducing one ton of CO was estimated at $13,020. Costs for reducing HC and NO_x were $71,023 and $109,649 respectively.

[6] VMT figures were not provided for 1995. Estimated by taking the average VMT per ride from the previous year. 2,100,000/500,000 = 4.2 miles per trip; 4.2 mile per trip × 54,400 rides = 228,480 VMT.

[7] Fares are already reduced to $0.50 on weekends.

TABLE 5-5. Smog alert program impacts on transit ridership, 1996.

	Ridership	VMT	HC (tons)	CO (tons)	NOx (tons)
Change	533,000	2,600,000	8.8	48	5.7
$/per	1.17	0.24	71,023	13,021	109,649

6 DALLAS–FORT WORTH — PROGRAM EVALUATION DATA

DESCRIPTION OF PROGRAM AND IMPLEMENTING AGENCIES

The North Central Texas Clean Air Coalition was formed in 1993 with the mission of increasing public awareness and understanding of the impact of clean air issues on North Texas and to aid the region in complying with the requirements of the 1990 Clean Air Act Amendments. Its member agencies include the Greater Dallas Chamber of Commerce, the Fort Worth Chamber of Commerce, the North Texas Commission, and the North Central Texas Council of Governments (NCTCOG). One of the first actions of the coalition was to form the Ozone Alert Day Action Program, which was modeled after a similar program in Tulsa, Oklahoma.

The 1996 budget for the Ozone Alert Day program was $250,000, with the majority of those funds coming from ISTEA and CMAQ sources. Primary uses of funding include transit subsidies and outreach efforts through advertising, workshops, a web site, and information hotline. In-kind contributions donated by local corporations and agencies include printing, phone, and fax network services.

Participating employers also offer incentives to their employees. These include:

- free or discounted transit fares
- free lunches
- support for flexible work schedules
- preferential parking and economic incentives for car and vanpools
- guaranteed emergency ride home for employees who rideshare or take transit.

The Texas Natural Resource Conservation Commission (TNRCC) supports the Ozone Alert Day program by providing pollution episode forecasting services and ongoing monitoring of regional air quality.

There is also participation by stationary sources in the region. These companies participate in a variety of ways on episode days, including reducing high-emitting activities, avoiding emissions-causing maintenance and landscaping activities, and switching to cleaner burning fuels. Stationary source participants receive public recognition for their efforts. While some of these sources report their operational changes to NCTCOG, no assessment of the emissions impacts of their efforts has been conducted to this point.

While TV commercials have probably reached out to the largest segment of the population, the Dallas program has also made focused efforts at educating the media and science teachers so that both groups can effectively and accurately pass on the message. The program has sponsored one-day workshops for science teachers and the heads of each school district and has occasionally sent speakers out to classes. In addition to giving teachers packets of information, the NCTCOG also operates an extensive Internet web site which contains information of the status of the alert day, basic information about the program and the health impacts of ozone, and annual exceedance and alert day statistics to show the effectiveness of

the program. The main page can be accessed at http://www.nctcog.dst.tx.us/envir/aq/aqhome.html.

Since the media has been fairly active at promoting the program, the coalition is now hiring an advertising firm to develop and post simple messages with the NCTCOG's phone number on billboards around Dallas. A phone number has a recorded message with the status of the alert day and directions for further information.

A summary chart of available data for the Dallas episodic control program is presented in Appendix A. The remaining sections of this chapter contain a more detailed discussion of this data. The discussion is divided into two sections, Direct Measures, consisting of survey and forecasting data, and Indirect Measures, summarizing regional transit data.

DATA ON DIRECT MEASURES

One survey was conducted in spring of 1996 by the National Service Reseach company to determine the public perceptions and understanding of air quality issues. The survey also included some questions regarding the respondents' knowledge of the episodic program and their willingness to voluntarily change their habits to improve air quality. In contrast to the surveys disussed for the other areas, the Dallas survey was more focused on finding out the motivations of the respondents so that improvements could be made to the public outreach component. No surveys were conducted later in the ozone season to determine changes in perceptions or to determine individual's responses to alert day notifications.

Public Perception of Air Quality Problem

The National Service Research survey incorporated questions aimed at determining the priority of air quality issues for the survey respondents. The following questions were included:

What are the top local public issues that are most important to you, such as; crime, education, etc.? (Do not read list and allow up to 5 answers)

- Health Care
- Crime/Violence
- Public Education
- Air Quality / Pollution
- Transportation
- Economy
- Jobs
- Budget Deficit

How would you rate each of the following issues regarding their importance to you on a scale from 1 to 5. (1-least important, 5 -most important)

- Crime / Violence
- Public Education
- Air Quality / Pollution
- Transportation

Do you feel the air quality in your country is a very serious, somewhat serious, or not a serious problem?

Do you feel the air has gotten worse, stayed the same, or gotten better over the past three years within your county?

The results indicated that relative to the other issues listed, only 7% mentioned that air quality/pollution was an important local issue. In contrast, crime/violence was the highest ranked issue (67%) with public education (49%) and health care (10%) following. Air quality fared slightly better on the second question:

Issue	Total Score
Air Quality	3.6
Crime/Violence	4.7
Public Education	4.4
Transportation	3.0

Of importance to note when examining these results is the different response received when compared to different types of local issues. It might make more sense to compare air quality to other environmental issues such as water quality, hazardous waste, or landfill space. With regard to the seriousness of air pollution, almost one-fourth of the respondents felt that air quality was a very serious problem, and almost half felt that air quality had gotten worse in their county.

The survey also included a number of questions to determine the public's basic understanding of air pollution and its sources.

> Are there some things residents can do to reduce air pollution?
>
> If yes, what can residents do to reduce air pollution? (Do not read list)

A significant majoity (80%) responded that there are actions that a resident can do to reduce air pollution. When asked about what those specific actions are, the majority of responses were related to cars and driving. The responses are shown in Figure 6-1.

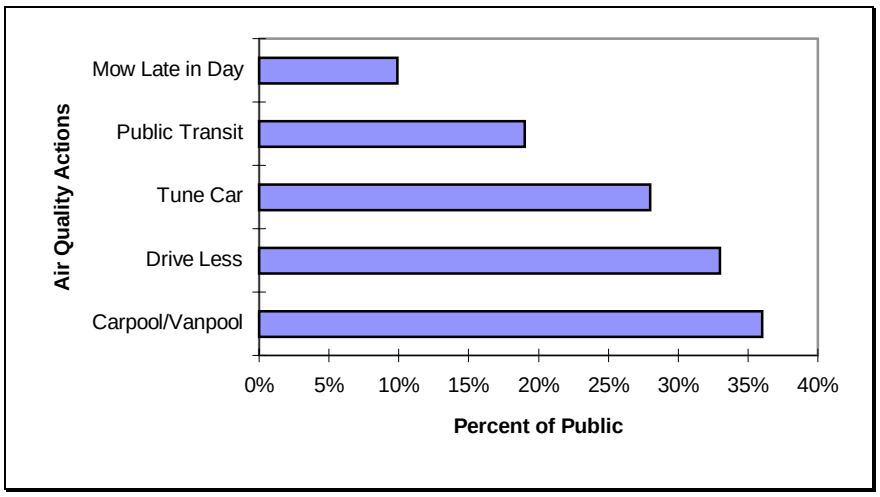


FIGURE 6-1. Public understanding of air quality.

Public Awareness of Program

Most of the questions on the survey probed the respondents regarding their knowledge of the "Do Your Share for Cleaner Air" program. Unlike many of the surveys conducted by other

cities, this survey contained specific questions regarding some of the components of their outreach program. Example questions are included below.

Have you seen or heard any messages, advertisements or slogans about air quality and ozone alerts within the past three months?

What did the advertisement, message or slogan say?

Have you seen or heard of ozone alerts or ozone action days?

Have you seen or heard the slogan or message "Do Your Share for Cleaner Air"

Have you seen or heard of Whiff, the clean air mascot?

Where did you see or hear this / these advertisements, messages or slogans?

What did the message or slogan mean to you?

- Drive less
- Carpool / Vanpool
- Take public transit
- Consolidate trips
- Ride bike / walk
- Reduce barbecue / fireplace use
- Keep car tuned
- Drive newer car
- Mow late in day
- Refuel in evening

How much, if any, have these slogans or messages increased your knowledge about clean air issues? (Would you say a lot, some or not at all?)

Do you know the difference between ground level ozone and upper atmospheric ozone? (Yes there is a difference, No difference, Don't know)

In response to the inital questions, a total of 28% reported that they had seen or heard messages, advertisements, or slogans about air quality or ozone alerts within the past three months. Because of the background questions asked of respondents, the survey indicated which county (Tarrant) and subgroup (Females over 55, earning incomes over $25,000) had the highest unaided awareness. With regard to recognition of the Dallas program, 60% were aware of the ozone alert program, 27% of the "Do Your Share for Cleaner Air" slogan, and 3% of the Whiff mascot. However, one-fourth of the respondents reported that the clean air message meant nothing to them. The breakdown of where people recall getting these messages is shown in Figure 6-2. The breakdown of responses concerning what the message meant was similar to that reported for what a resident could do with the most popular responses being: drive less (29%) and carpool/vanpool (19%). Concerning ozone, just over half responded that they did not know the difference and one-third stated that ground-level and upper atmospheric ozone are different.

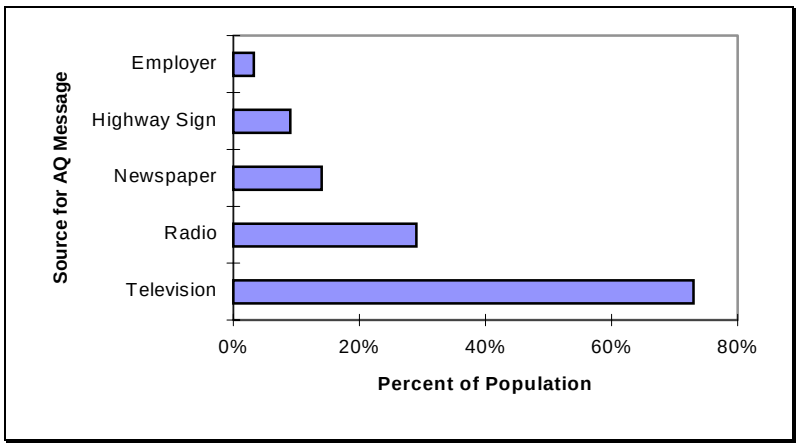


FIGURE 6-2. Source of program awareness.

Participation Level

There are 1500 companies included in the Dallas program. Many of the large employers in the area have committed to reducing lawn maintenance and other activities that can be put off on a short-term basis. Many employers have also pledged to educate their employees and offer incentives. Texas Instruments, for example, offers $1/day/carpool and preferential parking for carpools. It has also built storage lockers and installed showers as part of a bike program, and it encourages telecommuting.

Changes in Emission Producing Activities

The survey included several questions aimed at determining the public's willingness and potential motivating factors to take action to improve air quality. The following questions were included:

> Do you feel you need to personally change any of your habits in order for your county to have cleaner air?
>
> What are you willing to voluntarily change about your habits in order for this area to have cleaner air?
>
> If you are not willing to change anything - why?
>
> If you personally make changes in your habits, do you feel it will have a positive impact on air quality in this county? (A lot, Some, Not any, No opinion)
>
> If the air quality affected your health in some negative way, would you voluntarily change any of your habits in order to reduce air pollution?
>
> If the air quality affected you financially in some negative way, would you voluntarily change any of your habits to reduce air pollution?

The responses to the first couple of questions are interesting because they point out some important points concerning the wording of questions. Almost half of the respondents felt that they needed to change their habits; however 55% felt that they did not because (1) many of the respondents stated that they had already changed their habits or (2) they felt that there was no need. Similarly, just over one third were not willing to change their habits since they had already changed their habits, felt there was not need to change, or didn't know what else they could do. The breakdown of responses for those willing to change their behavior is

shown in Figure 6-3. Over half felt that changing their habits would have *some* positive impact on air quality and 12% thought it would have a *big* impact; however, 25% felt that it would have no impact at all. With regard to motivation, slightly more respondents report a willingness to change their habits *a lot*, if air quality negatively affected their health (41%) in contrast to their finances (35%). Similarly, about 40% would be willing to change *some of their habits* and 16% would not change any habits, regardless of impacts on their health or finances.

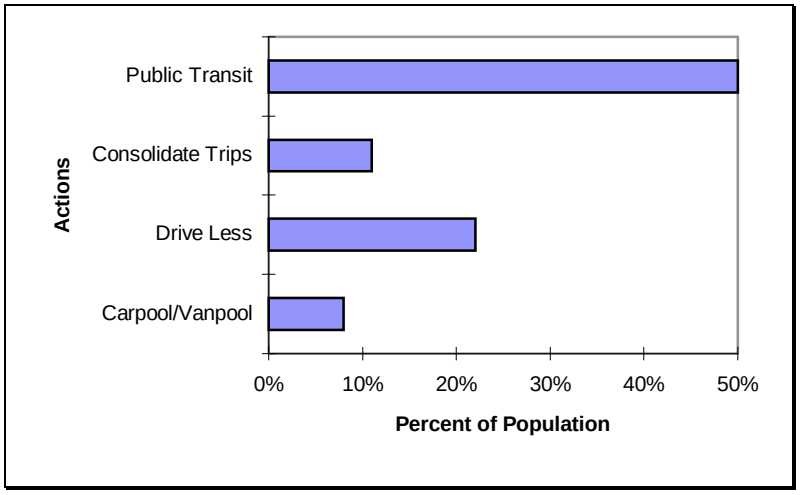


FIGURE 6-3. Public willingness to take action.

Forecasting

To help examine the accuracy of forecasting method used in Dallas, data for the summer of 1995 were analyzed. The TNRCC was contacted to obtain information on which monitoring sites are used to determine ozone exceedances. In addition, dates for which forecasting models predicted unhealthy air were also obtained.

Model forecasts of ozone concentrations in excess of 125 ppb in the Dallas area were made for 25 days during the summer of 1995. As seen in Figure 6-4, ozone exceedances (of the federal standard of 125 ppb) were observed on 12 of the forecast days. In addition, the ozone concentrations on three other days were also in exceedance of the ozone standard. Ozone exceedance information was based on the ozone concentrations of nine air quality sites within the Dallas area.

Forecasting Abilities

Forecasting for Ozone Action Days for the Dallas area is the responsibility of the meteorologist on duty at the Texas Natural Resource Conservation Commission (TNRCC). Ozone Action Day notices are released during the period May through October for all days (except Sunday) if the following meteorological conditions are forecast for the following day:

- The average wind speed for the period 10 a.m. through 4 p.m. CDT is less than 7 knots.

- The vector average wind direction for the period 10 a.m. through 4 p.m. CDT is greater than 50° and less than 240°(in the clockwise direction). (This is applied only if the ratio of the vector and arithmetic wind speeds is 0.5 or greater.)
- The maximum temperature is 90°F or greater.
- The average cloud cover from 10 a.m. through 4 p.m. CDT is clear to scattered.
- The maximum ozone concentration on the previous day is greater than 50 ppb.

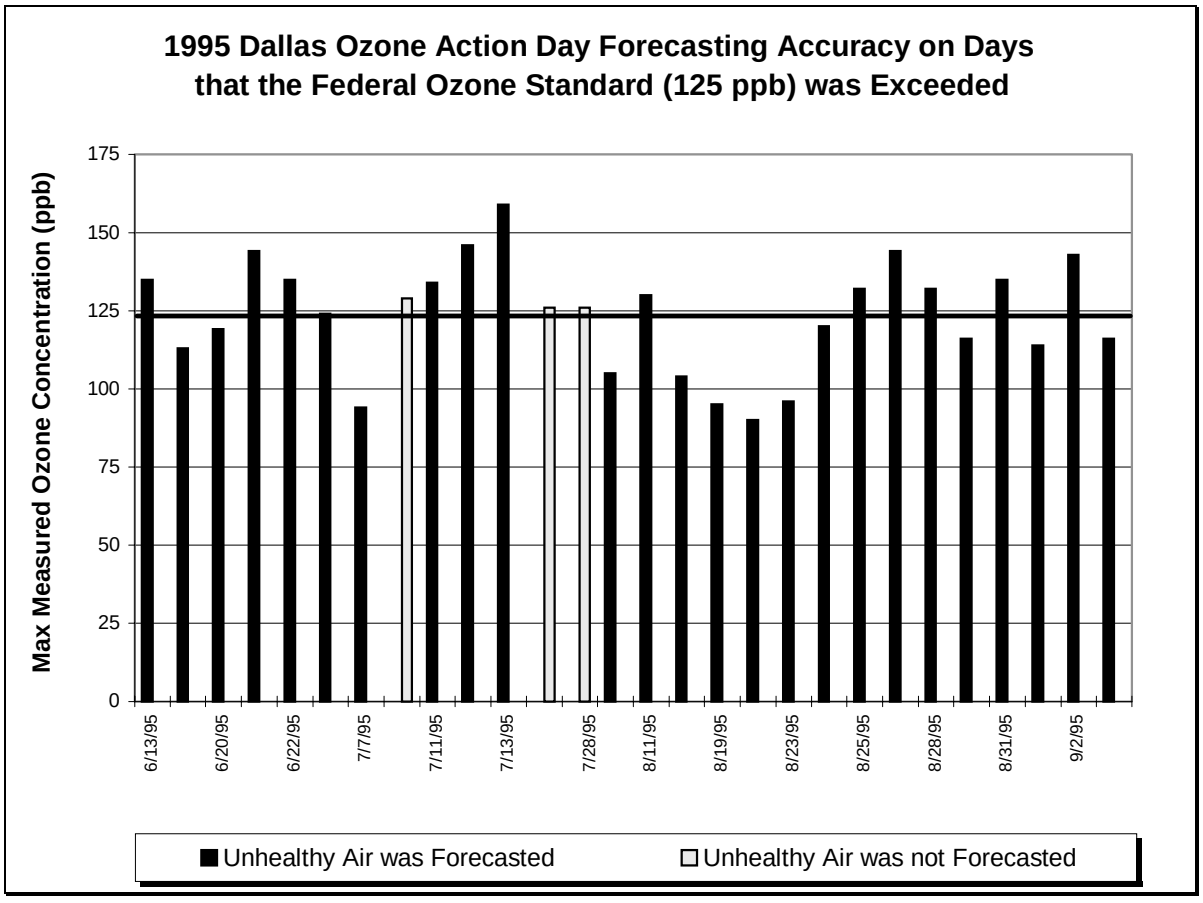


FIGURE 6-4. Forecasting accuracy in 1995.

Notification

If the above conditions are forecast for the next day, notifications for the initiation of an Ozone Action day begin by 2:30 p.m. CDT. The first step is for the meteorologist on duty at the TNRCC to call the National Weather Service (NWS) Office in Fort Worth and make a request for an Ozone Action Day notice to be released on the NWS communication lines. A call is also placed to the NCTCOG, which in turn contacts other North Texas Clean Air Coalition participants. On weekdays, the TNRCC meteorologist also disseminates the information to interested TNRCC staff (including those in Austin) via electronic mail. The TNRCC staff person in Austin then calls the U.S. Environmental Protection Agency and additional staff. On Sundays, the TNRCC meteorologist contacts the NCTCOG Ozone Hotline, TNRCC Media Relations, and weekend duty staff at the Regional Office.

The TNRCC on-duty meteorologist has the option of canceling the ozone action request on the day that the ozone action notice is in effect if it is felt that the weather conditions are not expected to be conducive to the formation of high-level ozone concentration. If a cancellation is made, a cancellation message is then released by the NWS.

Information on the status of the Ozone Action Day is available as a recorded message. This message is updated daily (Monday through Friday) and includes information on the peak ozone concentration for the previous day. On weekends, the message is updated only when an ozone action day is declared on the weekend.

The forecast meteorological conditions for each Ozone Action Day are verified using (NWS) meteorological data from the Dallas–Fort Worth Airport as well as analyzed using numerical weather guidance versus actual observed weather conditions. Information culled from the verification/comparison process is then used to refine future forecast criteria.

DATA ON INDIRECT MEASURES

Regional Travel Levels

Transit ridership is tracked on alert days by local transit agencies and tabulated by NCTCOG. On alert days when reduced transit fares were offered, ridership increases ranged from –0.6% to as much as 86%. A few examples of ridership statistics are shown in Table 6-1. The Dallas transit agency experienced the greatest increase in ridership in August 1996. The Fort Worth transit agency consistently had the largest increases in ridership. None of the transit agencies offered reduced fares on weekends or holidays.

TABLE 6-1. Transit ridership data for June/July 1996.

Date	Day of Week	Average Ridership	Actual Ridership	Ridership Increase	Comments
6/14/96	Friday	149,505	158,206	5.8%	No exceedance reported
6/21/96	Friday	149,505	153,766	2.9%	No exceedance reported
7/02/96	Tuesday	147,855	162,327	9.8%	No exceedance reported
7/03/96	Wednesday	147,855	159,051	7.6%	Exceedance reported

7 LESSONS LEARNED FROM EXAMINATION OF PROGRAM EVALUATION DATA

A systematic review of seasonal/episodic control programs - including a snapshot of the efforts underway across the country coupled with a specific review of five areas - sheds significant light on current data collection issues, quantification methodologies, and the potential effectiveness of seasonal/episodic control programs. While all of the areas included in the ICF report have expressed interest in quantifying the impacts of their programs, only a few have actually collected enough data to begin to develop emission estimates. Within these few areas, the data and quantification or estimation methodologies used vary widely. Based on our review of evaluation methods in place for seasonal/episodic control programs, it is apparent that current efforts do not provide sufficient data to support emission reduction claims.

Most programs are not designed to be evaluated and have not incorporated evaluation data as an important program element. Because these programs are voluntary, there currently is little incentive to invest the level of resources required to systematically survey a representative sample, on the day of each episode, to create a valid estimate. In addition, because these programs are relatively new, the vast majority of the area's resources have been funneled into program development efforts (e.g., designing materials, advertising) and not into program design or evaluation. There are potential policy tools that could be used to create additional resources for areas, change the incentives to collect data for evaluations, or redirect program funds into evaluation as programs mature. Nonetheless, concrete guidelines are needed for data collection and the development of emission estimates, especially if comparisons from area to area are desired, along with program changes over time.

The following sections outline the scope of the evaluation efforts currently underway and some interesting trends observed in the actual program evaluations. The remaining section goes into more depth regarding the specific data collection and analysis methods used by the five areas and their limitations.

SCOPE OF EVALUATION EFFORTS

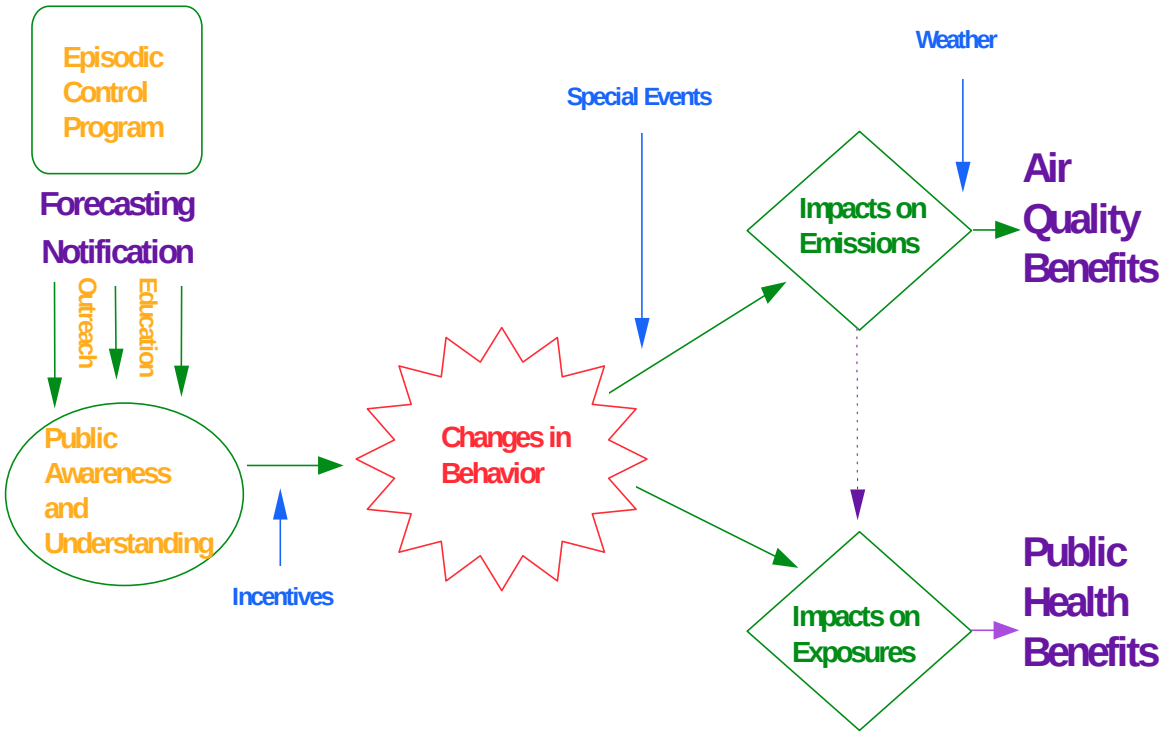
Seasonal/episodic control programs are being implemented in different areas across the country and these areas self-report three main goals for their programs:

1. Education of the public
2. Attainment or maintenance of air quality standards, and
3. Improvement of public health.

These goals of the implementing agency dictate what, if any, monitoring of results takes place and the kinds of program impacts that are evaluated. Of the five areas included in this study, Cincinnati, Dallas, and Sacramento reported that "attainment of air quality standards" was their number one goal for the program. San Francisco listed "maintenance of air quality standards" as their number two goal, and Baltimore listed

"attainment" as their number three goal. These last two areas, however, have been vocal about their interest in obtaining potential emission reductions from the program, if available. Thus, all of the areas are interested in developing methodologies to quantify the emission reduction impacts of these programs and have tried several methods to collect data for use in emission calculations.

The following graphic outlines the major components of a seasonal/episodic control program and the numerous points where data should be collected to fully evaluate the full range of potential benefits.



The methods used to evaluate episodic control programs also should be broadened on a large enough scale to better understand the impacts of "seasonal" control measures that are included in the overall scope of these programs. Most programs emphasize episodic controls that generally include a set of recommended actions for participants to reduce pollution on an intermittent or "episodic" basis (e.g., reduction of trips, postponement of certain activities), yet the public education programs typically also recommend activities that reduce emissions on a seasonal or longer-term basis (maintenance of cars). Long-term behavior change is the ultimate goal of most programs. *There is also anecdotal but unproven evidence that these seasonal/episodic control programs may assist state and local regulatory agencies with their implementation of regulatory programs such as Inspection and Maintenance. Several areas believe that the increased level of public awareness - to the seasonal/episodic program, general air pollution issues, and their personal role in solutions - have fostered a greater acceptance of regulatory programs.* The data collected by many areas on public willingness to participate in certain activities and long-term trends in transit ridership, for example, indicate that some of the suggested activities may best be viewed as "seasonal" controls. Efforts to disaggregate the emission reduction and other benefits from seasonal as opposed to episodic controls currently may be difficult, but should be emphasized. At a minimum, they should be included at least at a qualitative level when programs evaluate the results of their current techniques for quantifying emission reductions.

TRENDS IN QUANTIFICATION RESULTS/EFFORTS

All of the areas examined in this study have been collecting survey data to better understand the impacts of their public outreach and education programs. Most areas report fairly high (> 65%) public and/or business awareness of their programs and report consistent trends in:

- The public's perceptions of air quality issues - > 40 percent believe that air quality problems are serious and
- Air quality trends - > 40 percent believe air quality is getting worse.

Thus the motivation and potential willingness of the general public to participate in these programs does exist. The reasons why individuals participate in specific behavior changes over others and the potential role for incentives to augment this willingness is poorly understood. A few areas are beginning to collect data that may shed light on these questions.

Business/Employee Notification

The five areas report business and/or employer participation by anywhere from 100 to 1,500 companies. Not all of the areas have estimated the total number of employees reached through these companies, but some areas, such as Dallas, have estimated that the episodic program notification reaches approximately 600,000 employees. Some of the areas have asked companies to register with the program; these companies then agree to notify their employees when an alert is declared and agree to educate the employees about actions they can take to reduce pollution on those days. Other unregistered companies may also receive notification of alert days through the seasonal/episodic program's fax distribution network; however, the lead agency is not able to measure how many additional employees are notified by these companies[1].

Public Willingness to Participate

Most of the areas have collected survey data on the willingness of the public to participate in the seasonal/episodic control program. While the surveys given by the different areas vary significantly, the results indicate a willingness of the public (30–80%) to take action. In Baltimore, these participants were labeled as "early adopters," and were defined as those individuals who recognize the air pollution problem, agree that air pollution has negative consequences, agree that they contribute to the problem, and are willing to take action.

The survey results from most areas indicate that the public is more willing to participate in certain types of control measures than others. Survey results indicate that respondents are more willing to curtail certain activities, such as use of consumer products and lawn and garden tools, rather than to curtail driving. In all areas, the percent of the public that report reducing use of equipment that contributes to these area sources was significantly higher than those who reduced driving activity. In Sacramento, for example,

[1] Note that the agency may not know what percentage of employees from registered or unregistered programs are actually changing their behavior during episodic alerts. Therefore, estimates of the number of people that are notified through their employers provides only an upper bound on the possible number of employees that are participating.

approximately 33% responded that they had reduced motor vehicle activities in response to the alert day program; however, 50% responded that they had reduced the use of gas-powered garden equipment. For a program to be effective, especially for areas where area sources are a significant portion of their emission inventory, the seasonal/episodic control program can have more impact in reducing ozone levels if emphasis is expanded to include activities other than driving. *The review of seasonal/episodic control programs did not identify any hierarchy of activities that allowed the public to identify those activities that generated the most emission benefits. It is unclear whether such a list exists or would be useful in directing the public to choose among behavior changes.*

Emission Reductions

Two main methods are being used, by the areas examined in this study, to quantify emission reductions. The first method involves extrapolation of survey data. These data can indicate a level of awareness, willingness to participate, and self-reported changes in public behavior. When these data are combined with assumptions for key emission variables, the program can generate an estimate of reduced emissions. In Sacramento, for example, estimates of the number of people that have reduced driving on Spare the Air days have been obtained from survey results. Respondents were asked how many round trips they reduced by postponing trips or taking an alternative mode of transportation. From these data, the percentage of drivers in the survey that reduced trips and the number of trips reduced per driver were determined. Coupled with vehicle registration statistics and average trip length information, estimates of the number of total trips and VMT reduced in the Sacramento region were extrapolated and combined with emission factor data to estimate emissions reduced.

The other method, which was used in Cincinnati, involved examination of transit ridership data. The Southwest Ohio Regional Transit Authority (SORTA) provided bus service at a reduced (CMAQ subsidized) fare for the summers of 1994, 1995[2] and 1996. SORTA tracked increases in ridership over the budgeted ridership estimates[3] to determine if the Smog Alert program had any impact on transit ridership. The difference between these two figures were assumed to be reduced trips with corresponding emission reductions.

None of the areas has demonstrated emission reductions using ambient air quality data. There are some programs that evaluate the program's effectiveness using the following logic: if a high ozone day is predicted and an alert day is called but an exceedence does not occur, then the program is a success. No control experiments have been done (i.e., forecast the day and don't call it) to evaluate this technique.

Both the Sacramento and Cincinnati methods have limitations. In addition to limitations of the basic methodologies, survey design and timing, and data collection issues affect the accuracy of the emission estimates. The following sections discuss some of these concerns.

---

[2] Low fares were restricted to alert days in 1995.

[3] No data was provided by SORTA on assumptions that they used to estimate budgeted ridership.

LIMITATIONS OF EVALUATION TOOLS

Some of the data and assumptions required to quantify the impacts of seasonal/episodic programs are available and obtained from air quality planning agencies, but much of the key data—such as the level of public awareness and corresponding levels of emission-producing activity—are most readily obtained through surveys . Several survey techniques are used to collect data on public opinion and changes in people's behavior: telephone surveys, mail surveys, travel diaries, in-person interviews, and focus groups. Because seasonal/episodic programs are voluntary, with no mandatory requirements for individual behavioral changes, no other techniques exist besides market research/survey techniques to assess behavioral changes. Some areas have attempted to use proxy data, such as parking lot counts, to gain some level of insight into program effectiveness. These efforts have been largely unsuccessful.

It is difficult to attribute changes in trends data, such as ridership, ambient air quality levels, or public health (e.g., emergency room visits) to the operation of an seasonal/episodic control program since many factors affect these data. Nonetheless, these data are still valuable to track since they can provide supporting evidence of the effectiveness or ineffectiveness of a program. The systematic collection of data - regularly and uniformly - will improve the quality of evaluation efforts. In addition, there is also a high likelihood that continuing efforts to collect and evaluate these data will increase their value as evaluation tools and techniques improve.

Sample Bias

Survey techniques have some limitations. Only a small portion of the entire population can be included in a survey; the results from a small subpopulation must be extrapolated to the larger population. Any nonrespondent bias, or problems from choosing a nonrepresentative sample will be extrapolated in the survey results. Scheduling and timing issues also occur with survey implementation. Surveys given on different days of the week can produce different results. A survey given on the same day, with a different population subgroup, could also produce different results due to differences in the subgroup. All of these limitations should be understood whenever survey results are examined.

Survey Design

An examination of the surveys, furnished by the areas included in this study and other areas, has identified a number of issues regarding survey design and implementation. While many areas implemented surveys to assess public awareness and understanding, few areas did so to quantify changes in behavior. The surveys also differ significantly in their approaches; critical factors such as survey timing and survey wording, which impact the results of the survey, are not handled in a uniform manner by each agency. Because these factors can bias the survey results, the survey results often cannot be compared from one survey to another, and certainly cannot be compared from one program area to another. These factors and the associated biases are discussed below.

Survey Timing

The schedule with which surveys are implemented can greatly affect the accuracy of the survey results. Factors such as the time of year that the questions are asked, the day of the week (weekday or weekend), and whether or not it is a pollution episode day must be considered when putting together a survey. To gather information on the effectiveness of the outreach components of a program, most areas perform a survey early in the ozone season, which represents "before implementation" data. Another survey is performed later in the ozone season, giving an "after implementation" reading and allowing a before/after comparison. In Cincinnati, trends in public awareness at the beginning and end of the season are shown in Figure 7-1.

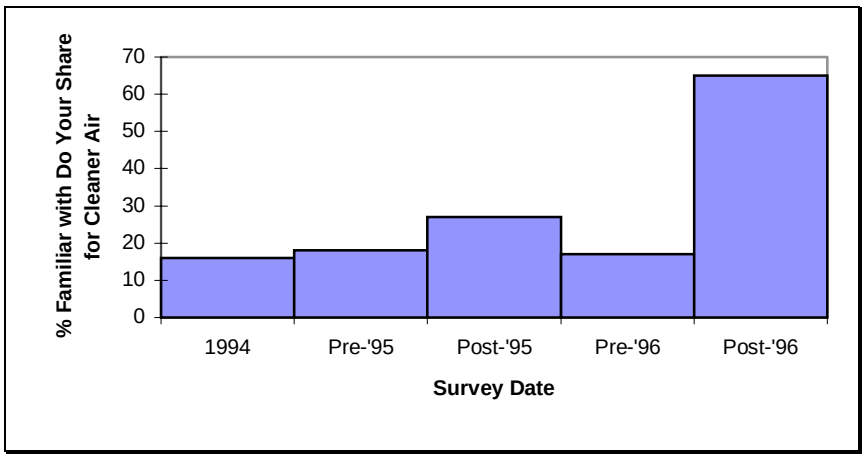


FIGURE 7-1. Public awareness before and after the ozone season.

To quantify changes in behavior (that lead to emission reductions or changes in exposure levels), surveys should be completed on specific seasonal/episodic days to ensure that the data are accurate and that respondents' memories do not influence the results of the study.

Survey Questions

The order and wording of questions also greatly influences response rates and the quality of the data collected. Some basic guidelines on survey question organization and content should be followed to help improve response rates, reduce respondent bias, and ensure that meaningful data are collected. The questions included in the San Francisco Bay Area survey, for example, were ordered to eliminate any bias as to the "preferred answer." The episode day survey began with the following three questions:

> In the past 2 days, did you drive your car or truck less frequently than you normally do? (yes, no, don't own car/truck)
>
> If yes, Why did you do instead of driving? (eliminate trip, carpool, use transit, walk...)
>
> Why did you make that change? (air quality related, other reason, both, don't know)

Due to the shortage of Spare the Air days forecast by the BAAQMD during the summer of 1996, this survey was given only twice, once in August and once in October. The first survey was administered on the evening of August 13 after a series of well-publicized

Spare the Air days. Twenty-five percent of the 412 respondents in the August survey indicated that they drove less in the past two days, with 11% of these saying that they did so for air quality related reasons. Overall this represents 4% of those interviewed. These results are significantly lower than the results reported in surveys in other areas that might include some respondent bias. However, the survey questions could have been alternatively worded to further reduce bias. For example, the first question could have been written to read:

> In the past 2 days, did you drive your car or truck more frequently, less frequently or the same as you normally do? (yes, no, don't own car/truck)

Thus, all bias to the "preferred answer" would be eliminated. Even with the slight bias included in the BAAQMD survey, the question wording was much less biased than some of the other questions reviewed. The other surveys included some of the following questions:

> Have you taken action or behaved differently based on hearing or reading about the Air Quality Index / Ozone Alert?

or, alternatively:

> This summer, officials in our area called a smog alert on some days and asked the public to avoid doing certain things that cause smog. Did you change any of your habits when these alert days were called? (Y/N/U) ___
>
> If yes, Please tell me what you changed or did differently as a result of poor air quality and smog alert days. (Do not prompt; X all that apply)
>
> Took the bus instead of driving
> Did the 50-cent fare rate influence your decision to take the bus? (Y/N) ___
> Rode bike instead of driving
> Carpooled
> Cut lawn or used lawn equipment after 6 p.m.
> Saved electricity
> Avoided use of paints and stains
> Avoided filling gas tank until after 6 p.m.
> Kept car tuned up/maintained
> Didn't use aerosol cans
> Other; describe:

Even though the respondent is not prompted with the answers to these questions, it is clear from the wording and ordering of the questions that they are being asked to make a response to reduce air pollution. Responses to these questions are more likely to include actions to improve air quality than those in the Bay Area survey.

Travel Behavior

It should be noted that potentially important travel-related issues are not addressed in any of the surveys in this study. The surveys do not ask whether a vehicle left at home by the respondent on an alert day was used by someone else in the household during that time, nor do they ask whether people drove their car to a park-and-ride lot to catch a carpool or transit. If either of these situations occur, then any emissions benefit expected may be lessened or may not be realized at all. Inserting additional questions to identify these respondents will improve any travel and emissions estimates made from the survey data.

Not including them could cause overestimation of the travel and emission reductions attributed to the program, although it is unclear by how much.

Motivation for Behavioral Change / Survey Feedback Mechanisms

Few areas have done surveys examining the effectiveness of specific community outreach material. For instance, the Dallas survey focused on finding out the motivations of the respondents so that improvements could be made to the public outreach component. However, no surveys were conducted later in the ozone season to determine any changes in perceptions or to determine if people had responded to alert day notifications. Therefore the agency could not assess the impact of any specific changes that were made to the outreach material, and no improvements could be completed[4]. Other survey mechanisms such as in-person interviews and focus groups are typically used to obtain more detailed information from a smaller number of people and could be effective at determining this type of evaluation. These methods allow face-to-face contact between interviewers and participants. The main advantages of these methods are that the environment is controlled, interviewers can get a "feel" for respondents and their attitudes/biases, questions can be easily answered, props and exhibits can be used to convey ideas or ask questions, and more time is available for detailed responses.

SUMMARY

To ensure that the emission estimates calculated by programs are realistic, the area should have a seasonal/episodic program that is sufficiently developed to produce significant behavioral changes and the subsequent changes in emissions.[5] These programs must contain all of the core elements associated with a successful program. Each of these elements, in turn, must be evaluated to confirm the overall benefit of the program. Thus, these programs will have to include actions to quantify the effectiveness of program elements. For example, if emission reductions from participating companies are important to the effectiveness of a program then the area must ensure that all participants (companies/employers) are notified of the episodic event in a timely manner. To measure this, an annual fax survey, concerning the accuracy and completeness of the fax tree service, could be given. A survey of this type was given to determine if the fax tree service one program was using, was

1. Using the correct phone numbers,
2. Notifying the correct personnel,
3. Notifying the personnel in a timely manner and
4. Providing all of the information needed by the participating companies.

Deficiencies in the fax tree service were noted in the survey and improvements were incorporated into the overall program.

Emission reductions estimated by areas implementing seasonal/episodic control programs should also be viewed as they pertain specifically to the seasonal/episodic

[4] The program contact did not indicate whether any changes were made to the outreach material in response to the survey results.

[5] *All* programs, however, should be evaluated, from the initial years, to track historical trends (air quality, forecasting accuracy, awareness) and provide accountability.

control program. While some areas have a general sense for how many alert days occur in a typical year, the emission reductions should not be applied when examining emission reductions for attainment of long-term standards such as annual standards. If included as part of a SIP attainment demonstration for a short-term standard, any limitation that pertains to the seasonal/episodic control program should also pertain to the emission reduction. For example, if the implementing agency states that the forecasting methodology used in the area is only reliable for multi-day episode periods, the emission reduction credits estimated for the program should only be applied in attainment demonstrations for multi-day episodes.

Many areas might not be interested in estimating specific emission reductions associated with their programs, but would still be interested in adding legitimacy or recognition to their program. Furthermore, while techniques to quantify the programs do exist, the accuracy of these estimates over time depends upon continued implementation of an effective seasonal/episodic control program. Thus, to ensure that emission reductions continue into future years examined in a SIP attainment demonstration, EPA should require that seasonal/episodic control programs maintain critical program elements that ensure that the program is successful. Some of the factors that make a program successful are highlighted in our previous document, but it is also worth noting that these seasonal/episodic control program performance standards must also be flexible enough to allow areas that are only interested in gaining legitimacy for their programs, to meet minimal standards.

The remaining points included in this chapter are associated with methods available to evaluate seasonal/episodic control programs. When attempting to evaluate a seasonal/episodic control program, areas should:

- Evaluate *all* program components using *all* of the tools available, and
- Use the available tools with a clear understanding of data collection limitations.

It is worth mentioning that with the limitations of the current tools and because the overall seasonal/episodic control program must be effective for any emission reduction credits to continue, all aspects of the seasonal/episodic control program should be evaluated on a periodic basis. Generally speaking, the main goal of seasonal/episodic control programs is to improve air quality by educating the public about local air pollution problems and actions they can take to reduce emissions. Several general criteria can be used to gauge whether a program can achieve these objectives: (1) whether public awareness of air pollution issues and the seasonal/episodic control program itself is increasing or continuing at a high level, (2) whether all of the seasonal/episodic program components are working well together, and (3) whether the public is reducing emission-producing activities on seasonal or pollution episode days. To evaluate the impacts of a seasonal/episodic control program, data must be collected in all of these areas. Unless the public education and awareness programs continue, behavioral changes monitored in one year may not continue to future years. On the other hand, unless the implementing agency is able to correctly forecast alert days and notify the public, the program will not reduce emissions. Finally, unless public behavior is monitored in an unbiased manner, the agency can only guess at potential emission reductions.

It is also important to note that survey results and trends analyses must be viewed with a critical eye and repeated on an annual basis. As mentioned previously, data collected

using market research tools can vary with factors not associated with the seasonal/episodic control program, such as changes in sample populations and day of the week. In addition, over time, most public education programs are designed to expand the application of the program to a larger percentage of the population and instill some long-term behavioral changes. Both of these components will affect behavioral changes. Therefore changes in public behavior should be monitored on a yearly basis. Key facets of survey design include:

- Identification of survey objectives
- Determination of the survey mechanism
- Specification of the sample size and determination of participants
- Development of survey
- Survey implementation, data coding/error checking
- Examination and interpretation of results
- Development of follow-up actions.

All of these are important elements; no steps should be skipped due to limited resources. A survey to determine the public's response to particular outreach material is quite different from a survey to identify obstacles that businesses have to participating in the seasonal/episodic program. Identification of *specific* objectives must be completed so that the appropriate survey mechanism and questions are correctly chosen. Phone surveys typically have quick turnaround times, high response rates, and low nonresponse bias rates compared to mail surveys; however, in some instances mail or focus group surveys are more appropriate mechanisms since these types of surveys can ask more probing questions regarding issues such as motivation or perception. Established industry standards regarding sample size[6] and question/response wording should be followed to ensure that accurate and meaningful findings can be made from the data collected. Finally, the results of the survey should be examined and program changes/improvements, additional surveys, or recommendations for further studies should come out of the survey findings.

[6] Sample sizes should be set so that subgroups contain at least 100 respondents (using estimated response rates and estimated subpopulation percentages)

8 RECOMMENDATIONS

Given the limitations and data collection issues discussed previously, we suggest that EPA consider the following recommendations concerning the support of these voluntary programs and the development of specific methods to evaluate seasonal/episodic control programs.

FUTURE STEPS - SUPPORTING DEVELOPMENT OF EPA-ACCEPTABLE PROGRAMS

With respect to the role of the Agency in supporting these programs, it is apparent from discussions with program managers and the amount and quantity of available data that the following activities would be useful:

- Evaluate the current regulatory framework to identify opportunities to allow areas to obtain emission reduction credits for verifiable emission reductions;
- Set performance standards for areas hoping to get "quantifiable credits" with regard to all aspects of program design, for example: forecasting accuracy; notification of participants; and inclusion of defensible program quantification techniques (e.g., survey frequency, sample size, and statistical accuracy).
- Develop *de minimus* performance criteria for area's wanting 'recognition' (as opposed to quantifiable credits) for their seasonal/episodic program with regard to program elements such as program design, use of notification systems, development of public outreach materials, and inclusion of program evaluation/feedback techniques.
- Develop a guidance document that captures the best practices from around the nation in the areas of Program Design, Forecasting, Notification, Public Education, and Program Evaluation;
- Support the development of a clearinghouse of information so that programs that are interested in sharing information can post and retrieve information (e.g., outreach materials, surveys, survey results) from a central, web-based area;
- Support collaborative research efforts to improve (1) forecasting methodologies with particular emphasis on improving the ability of areas to predict the first days of ozone exceedence episodes and (2) ambient air quality data analyses to evaluate emission reductions from seasonal/episodic control programs.
- Support collaborative efforts among the federal government departments and agencies in areas of mutual interest such as (1) an EPA-DOT effort to better understand the role of transit subsidies in reducing emissions and increasing transit ridership and (2) and EPA-HHS effort to better understand the potential for seasonal/episodic control programs to notify susceptible populations of high ozone days and limit their exposure.

FUTURE STEPS - PROGRAM EVALUATION & QUANTIFICATION

Access to credits could be a significant motivating factor for the development and improvement of seasonal/episodic control programs. Most significantly, improvement in data collection and analyses could be encouraged and developed with the availability of emission credits. With additional resources and research into better estimation techniques, areas could complete the additional surveys and data analysis required to develop more supportable emission estimates. To ensure that program evaluation data are collected in the future using techniques acceptable to EPA, the agency should

- Set specific criteria for survey design, implementation, and analysis to ensure that national data meet a minimum set of statistical methodology criteria; and
- Support the development of core surveys that programs can use to begin to collect data that will allow cross city comparisons and an analysis of historical program trends associated with program changes.
- Develop corelations between more ‘resource intensive’ methods to quantify program impacts and other less resource intensive methods.

APPENDIX A

SUMMARY OF AVAILABLE DATA

Baltimore - Measures of Program Effectiveness

Direct Measures	Methods to Collect Data	Available Data	Source
(1) Number of participants			
general public	public survey	D.C. / Baltimore area population	Agency estimates
# of companies	company survey, direct comm with companies	40 ENDZONE partners and 2.5 million people after first year	
# employees	company survey, direct comm with companies	Baltimore had 51 partners as of July 2, 1996	
# of stationary sources	company survey, direct comm with companies		
(2) Public awareness level of program	public survey	85 % have heard of Air Quality Index in D.C. In 1995, 44% have heard of an Ozone Alert in Baltimore. This number was 61% in 1996.	1995 Gallup Survey
(3) Public perception of the air quality problem	public survey	On a scale of 0 to 10 (0=no problem, 10=very big problem): D.C., 43% 7-10, 42% 4-6, 10% 0-3; Baltimore, 46% 7-10, 40% 4-6, 14% 0-3	1996 I/M Survey
(4) Changes in emission-producing activities		In D.C. 39% have taken action or behaved differently based on hearing about Air Quality Index. 16% in Baltimore.	
• travel-related activities			
VMT	public survey, company survey		
# trips (hot/cold starts)	public survey, company survey		
speed (& accel/decel)	public survey, company survey		
idling, park time	public survey, company survey		
vehicle type used	public survey, company survey		
time of day trips are taken	public survey, company survey		
frequency of vehicle tuneups	public survey, company survey		
refueling time of day	public survey, company survey		
• area source activities		n/a	
charcoal lighter fluid	public survey		
gas-powered garden equipment	public survey, company survey, survey of landscape companies		
household painting & aerosol use	public survey		
maintenance (painting, degreasing, tank cleaning)	company survey		
wood stove and fireplace usage	public survey, smokestack plume counts		
• stationary source activities	company survey	n/a	
Indirect Measures	**Possible Sources of Info**	**Available Data**	**Source**
(1) Indicators of regional travel levels			
traffic counts	Transportation/planning agency		
gas sales	Oil companies and refineries		
transit ridership	Transit agency		
HOV lane use	Transportation/planning agency		
car/vanpool program participation	Parking lot counts		
parking lot usage			
(2) Indicators of regional air quality			
ambient air monitoring	Air pollution control district, EPA		
visibility	Air pollution control district, EPA		
regional health trends (i.e. ER visits vs. O3 exceedances)	Public health agency, public health literature	Baltimore/DC - 664/599 hospital admissions and 1992/1797 emergency room visits attributable to ozone in 1994.	Harvard School of Public Health study for ALA
complaints to air quality hotlines	Program hotline records		

Sacramento—Measures of Program Effectiveness

Direct Measures	Methods to Collect Info	Estimate	Source
(1) Number of participants			
general public	n/a	n/a	SMAQMD
# of companies	registered companies	137	estimates
# employees	communication with companies	> 150,000	
# of stationary sources	n/a	none	
(2) Public awareness of program*	public surveys	73% (Th - Sat)	1996 mini-poll
		58% (weekend)	1995 mini-poll #1
		80% (weekday)	1995 mini-poll #2
		77% (weekday)	1995 annual survey
(3) Public perception of the air quality problem	public survey	89% - very or somewhat serious	1995 annual survey
• a serious problem?		66% - gotten worse /	1995 annual survey
• getting worse or better?		4% - gotten better	
(4) Changes in emission-producing activities			
• travel-related activities			
VMT	public surveys	1,877,568 mi./day red (wkend)	1995 mini-poll #1
		3,225,600 mi./day red (wkday)	1995 mini-poll #2
		4,324,320 mi./day red (Th-Sat)	1996 mini-poll
# trips (hot/cold starts)	public surveys	335,280 trips red./day (weekend)	1995 mini-poll #1
		384,000 trips red/day (weekday)	1995 mini-poll #2
		617,760 trips red./day (Th-Sat)	1996 mini-poll
speed (& accel/decel)	n/a		
idling, park time	n/a		
vehicle type used	n/a		
time of day trips are taken	n/a		
frequency of vehicle tuneups	n/a		
refueling time of day	n/a		
• area source activities			
charcoal lighter fluid	public survey	49% didn't use on alert days	1995 annual survey
gas-powered garden equipment	public survey	50% didn't use on alert days	1995 annual survey
household painting/aerosol use	public survey	0.3% didn't use aerosols on alert days	1995 annual survey
company maintenance (painting, degreasing, tank cleaning)	n/a		
wood stove and fireplace usage	n/a		
• stationary source activities	n/a		

Indirect Measures	Agency	Estimate	Source
(1) Indicators of regional travel levels			
traffic counts	Cal. Dept. of Transportation	Reviewed 1995 freeway data but found no reduction in flows on Spare the Air days	
gas sales		n/a	
transit ridership	n/a	Reviewed 1995 bus data but	
	Sacramento Regional Transit District	found a reduction in use on Spare the Air days	
HOV lane use			
car/vanpool program participation	n/a		
parking lot usage	n/a	Reviewed 1995 data but found no	
	City of Sacramento	decrease in parking lot usage	
(2) Indicators of regional air quality			
ambient air monitoring	SMAQMD, USEPA		
visibility	SMAQMD, USEPA		
regional health trends	n/a		
complaints to air quality hotlines	n/a		

* Percent that heard or saw the program's message not to drive, not those that recognize the program name or its slogan.

San Francisco Bay Area—Measures of Program Effectiveness

Direct Measures	Methods to Collect Info	BAAQMD Estimates	Source
(1) Number of participants			
general public	public survey	SF Bay Area population	BAAQMD
# of companies	company survey, direct comm with companies	650 companies	estimates
# employees	company survey, direct comm with companies	500,000 employees	
# of stationary sources	company survey, direct comm with companies	Not part of program	
(2) Public awareness level of program	public survey	67%-slogan, 57%-alert day, 92% purpose of program	1996 episodic study
		24% - slogan	1990, 1995 surveys
(3) Public perception of the air quality problem	public survey	49%-somewhat serious problem, 37%-getting worse, 77%-air pollution somewhat or very harmful	1990, 1995 surveys and 1995 focus groups
(4) Changes in emission-producing activities			
• travel-related activities			
VMT	public survey, company survey	24% -Reduce driving (10.% for AQ reasons)	1996 episode day survey
# trips (hot/cold starts)	public survey, company survey		
speed (& accel/decel)	public survey, company survey		
idling, park time	public survey, company survey		
vehicle type used	public survey, company survey		
time of day trips are taken	public survey, company survey		
frequency of vehicle tune-ups	public survey, company survey		
refueling time of day	public survey, company survey		
• area source activities			
charcoal lighter fluid	public survey	21% reduction in consumer products (27% due to AQ reasons)	
gas-powered garden equipment	public survey, company survey, survey of landscapers using gas-powered equipment	19% reduction in garden tools (30% for AQ)	
household painting/aerosol use	public survey		
company maintenance (painting, degreasing, tank cleaning)	company survey		
wood stove and fireplace usage	public survey, smokestack plume counts		
• stationary source activities	company survey		

Indirect Measures	Possible Sources of Info	BAAQMD Estimates	Agency
(1) Indicators of regional travel levels			
traffic counts	Transportation/planning agency		
gas sales	Oil companies and refineries		
transit ridership	Transit agency		
HOV lane use	Transportation/planning agency		
car/vanpool program participation	Transportation/planning agency		
parking lot usage	Parking lot counts		
(2) Indicators of regional air quality			
ambient air monitoring	Air pollution control district, USEPA		
visibility	Air pollution control district, USEPA		
regional health trends (i.e. ER visits vs. O3 exceedances)	Public health agency, public health literature		
complaints to air quality hotlines	Program hotline records		

Cincinnati—Measures of Program Effectiveness

Direct Measures	Methods to Collect Data	Available Data	Source
(1) Number of participants			
general public	public survey	Cincinnati Population	Agency estimates
# of companies	company survey, direct communication with companies	1200 companies	
# employees	company survey, direct communication with companies	> 60,000 employees	
# of stationary sources	company survey, direct communication with companies	None	
(2) Public awareness level of program	public survey	65%-aware of program	1996 public survey
(3) Public perception of the air quality problem	public survey	80%-average to very bad problem, 85%-air pollution has a significant impact on public health	1995 public survey
(4) Changes in emission-producing activities			1995 public survey
• travel-related activities		50% changed habits on alert days	
VMT	public survey, company survey		
# trips (hot/cold starts)	public survey, company survey	<10% -carpooled	
speed (& accel/decel)	public survey, company survey	<5% rode bus or biked	
idling, park time	public survey, company survey	< 5% tune-up car	
vehicle type used	public survey, company survey		
time of day trips are taken	public survey, company survey		
frequency of vehicle tune-ups	public survey, company survey		
refueling time of day	public survey, company survey	27% refueled after 6 pm	
• area source activities			
charcoal lighter fluid	public survey		
gas-powered garden equipment	public survey, company survey, survey of landscapers using gas-powered equipment	41% mowed after 6 pm	
household painting & aerosol use	public survey	<5% reduction in painting after 6 p.m.	
company mainten (i.e painting, degreasing, tank cleaning)	company survey		
wood stove and fireplace usage	public survey, smoke-stack plume counts		
• stationary source activities	company survey		
Indirect Measures	**Possible Sources of Info**	**Available Data**	**Source**
(1) Indicators of regional travel levels			SORTA analysis of transit ridership
traffic counts	Transportation/planning agency	n/a	
gas sales	Oil companies and refineries	'94-~500,000 trips	
transit ridership	Transit agency	'95 - 54.400 trips	
HOV lane use	Transportation/planning agency	'96 - 533,000 trips	
car/vanpool program participation	Transportation/planning agency	n/a	
parking lot usage	Parking lot counts	n/a	
(2) Indicators of regional air quality		n/a	
ambient air monitoring	Air pollution control district, USEPA		
visibility	Air pollution control district, USEPA		
regional health trends (i.e. ER visits vs. O3 exceedances)	Public health agency, public health literature		
complaints to air quality hotlines	Program hotline records		

Dallas—Measures of Program Effectiveness

Direct Measures	Methods to Collect Info	NCTCOG Efforts	Source
(1) Number of participants			
general public	public survey	North Central Texas population	NCTCOG
# of companies	company survey, direct communication with companies	~1500 companies with about 600,000 employees	estimate
# employees	company survey, direct communication with companies		
# of stationary sources	company survey, direct communication with companies		
(2) Public awareness level of program	public survey	27%-slogan, 60%-alert day, 3% mascot	1996 episodic pre-survey
(3) Public perception of the air quality problem	public survey	25% felt AQ in their county a serious problem 50% said it had gotten worse	1996 episodic pre-survey
(4) Changes in emission-producing activities			
• travel-related activities			
VMT	public survey, company survey	80% said there were actions they could take to improve AQ: 25% would tune car, 22% would drive less, 11% would consolidate trips, 8% would carpool, 5% would take transit	
# trips (hot/cold starts)	public survey, company survey		
speed (& accel/decel)	public survey, company survey		
idling, park time	public survey, company survey		
vehicle type used	public survey, company survey		
time of day trips are taken	public survey, company survey		
frequency of vehicle tune-ups	public survey, company survey		
refueling time of day	public survey, company survey		
• area source activities			
charcoal lighter fluid	public survey		
gas-powered garden equipment	public survey, company survey, survey of landscapers using gas-powered equipment	9.9% aware mowing late in day can improve AQ	
household painting/aerosol use	public survey		
company maintenance (i.e painting, degreasing, tank cleaning)	company survey		
wood stove and fireplace usage	public survey, smokestack plume counts		
• stationary source activities	company survey		

Indirect Measures	Possible Sources of Info	Estimate	Agency
(1) Indicators of regional travel levels			
traffic counts	Transportation/planning agency	Transit ridership on episode days compared with same day a week prior; reduced fares on episode days DART - increase 2.9 to 12.31% T - increase 18 to 86% SPAN - increase –0.6 to 35.2%	Dallas Transit Fort Worth Transit Authority
gas sales	Oil companies and refineries		
transit ridership	Transit agency		
HOV lane use	Transportation/planning agency		
car/vanpool program participation	Transportation/planning agency		
parking lot usage	Parking lot counts		
(2) Indicators of regional air quality			
ambient air monitoring	Air pollution control district, USEPA	Exceedances monitored by TNRCC	TNRCC
visibility	Air pollution control district, USEPA		
regional health trends (i.e. ER visits vs. O3 exceedances)	Public health agency, public health literature		
complaints to air quality hotlines	Program hotline records		

APPENDIX B

SURVEY RESULTS

SURVEY RESULTS FOR BALTIMORE

(Survey results were presented in April of 1995)

Survey 1 "General Awareness"

Number of Completed Surveys

Baltimore City	201
Northern Counties	262
Southern Counties	256
Total	719

Q. Which of the following do you feel is of most concern to Baltimore?

Air pollution	37%
Water pollution	27%
Disposal of solid waste	19%
Toxic waste	8%
Noise pollution	3%
Accidents at nuclear plants	3%

Q. On a scale of zero to ten, where a "10" means you feel it is a very big problem and a "0" means that you feel it is not a problem, how much of a problem do you feel air pollution is in your city or area?

There is a problem (7-10 rating)	46%
In the middle (4-6 rating)	40%
Not a problem (0-3 rating)	14%

Q. Which of the following do you feel is the biggest contributor to air pollution in your area?

Automobiles	35%
Trucks	18%
Buses	10%
Mftg/Industry	24%
Small engine fumes	3%
Utility companies	3%
Small businesses	3%

Percent who have heard of ground level ozone	36%
Percent who believe that ozone high up in the sky keeps out harmful radiation and ozone at ground level is a harmful invisible gas that we breathe	58%
Percent who have heard of an Ozone Alert	44%
	% Who Strongly Agree
Air pollution can have an impact on people's health	82%

Air pollution affects the Chesapeake Bay	55%
Air pollution negatively affects your quality of life	52%
Air pollution is much more harmful to children than adults	41%

Q. What, if anything, do you think you, as an individual, do to contribute to air pollution? (multiple responses allowed)

Drive car/vehicle	69%
Use small engines	4%
Cooking outdoors	2%
Use fireplace	7%
Use paints/solvents/etc.	4%
Using fossil fuels to heat	3%

Q. Who do you feel is responsible for reducing air pollution and cleaning up Baltimore's air?

Everyone/each of us	47%
State government	17%
Federal government	5%
Factories or industrial sites	5%
Automobile manufacturers	4%
Cities/communities	8%
Businesses	3%
Other	6%

% of residents who strongly agree that they personally can make a difference in cleaning up the air 39%

Q. Would you be very willing, somewhat willing, not very willing, or not at all willing to personally take actions that would reduce air pollution?

Very willing	33%
Somewhat willing	56%
Somewhat unwilling	6%
Very unwilling	3%
Don't know	1%

Of all persons interviewed, 16% have taken action or behaved differently based on hearing or reading about an Ozone Alert.

Of those who are aware of an Ozone Action Alert, 36% have taken action or behaved differently based on hearing or reading about the Alert.

Q. Do you agree or disagree that it is appropriate for employers to share information with their employees that would encourage them to take actions to reduce air pollution, particularly alerting employees of upcoming "bad air" days - when air quality is expected to be unhealthy? Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly that this communication is appropriate for employers to make?

Agree strongly	49%
Agree somewhat	32%
Neither agree or disagree	6%
Disagree somewhat	6%
Disagree strongly	6%
Don't know	1%

Survey 2 "Identifying Early Adopters"

Number of Completed Surveys 267

Criteria for early adopters:

Early adopters are those residents who...
- -Recognize the air pollution problem
- -Agree that air pollution has negative consequences
- -Agree that they, as individuals, contribute to the problem
- -Are willing to take action

% Residents who are early adopters

Overall	34%
Baltimore City	41%
Northern Counties	28%
Southern Counties	36%

Q. What would you say is the primary reason that you would be willing to take actions that would reduce air pollution? (unaided)

Concern for health	25%
Concern for my health	20%
Concern for children's health	23%
Concern for future generations	19%
Can see poor air quality	3%
To improve the environment	3%
Other	5%
Don't know	3%

Q. How willing or unwilling would you be to do each of the following? (Shown as % willing)

Yearly auto tune-ups	89%
Seek out environmentally friendly cleaners	76%
Avoid oil based paints	79%
Combine trips by car	68%
Limit use of motor boat/jet ski	39%
Cut grass less often	63%
Use alternative transit mode	38%
Trade in gas powered lawn equipment	33%

Survey 3 "Business Awareness Survey"

Number of Completed Surveys	241

Q. Which of the following do you feel is of most concern to Baltimore?

Air pollution	44%
Water pollution	23%
Disposal of solid waste	19%
Toxic waste	7%
Noise pollution	1%
Accidents at nuclear plants	1%

Q. Which of the following do you feel is the biggest contributor to air pollution in your area?

Automobiles	50%
Trucks	12%
Mftg/Industry	24%
Buses	5%
Small businesses	1%
Small engine fumes	1%
Utility companies	0%

Who do you feel is responsible for reducing air pollution and cleaning up Baltimore's air?

Everyone/each of us	35%
State government	21%
Federal government	11%
Factories or industrial sites	10%
Automobile manufacturers	5%
Cities/communities	3%
Businesses	4%
Other	6%

% Who strongly agree with the following statements

Air pollution can have an impact on people's health	79%
Air pollution negatively affects your quality of life and that of employees	51%
Your business is concerned about the quality of air in your area	44%
Air pollution affects the Chesapeake Bay	55%

% Who strongly agree with the following statements

Air pollution has a negative effect on economic development	52%
Air pollution could limit new businesses in the area	38%
You understand how the CAAA affects your business	39%
Your business can make a difference	25%
Poor air quality can affect bottom line	26%

Q. Considering all aspects of your business, how important to your business plans and considerations are environmental concerns and their impact on your business?

Very important	39%
Somewhat important	42%
Not very important	13%
Not at all important	5%

Percent who have heard of ground level ozone 47%

Percent who believe that ozone high up in the sky keeps out harmful radiation and ozone at ground level is a harmful invisible gas that we breathe. 60%

Percent who have heard of an Ozone Action Alert 47%

Percent of businesses who have ever taken action or behaved differently based on hearing or reading about an Ozone Alert 8%

Q. Would you say your business does a great deal, a fair amount, not very much at all to help reduce air pollution or clean up the air?

A great deal	16%
A fair amount	43%
Not very much	17%
Nothing at all	22%

Q. Does your company offer or support the following programs?

Telecommuting options	25%
Ride matching services for car pools	22%
Metrochek/Transit plus	21%
Preferential parking	17%
Compresses work week	11%

Q. If you know that the following could help reduce air pollution in your area, how willing would your company be to do each of the following on a voluntary basis? (% very willing)

Share info. with employees on bad air days	54%
Offer rideshare programs	20%
Be part of business partnership	25%

Q. What is the primary reason that your business would be willing to take actions that would reduce air pollution? (Open ended)

Impact on health (unspecified)	24%
Part of civic responsibility	37%
Concern for future generations	28%
Right thing to do	18%
Worry about employees health	9%
Mandate/Laws	5%
Good bottom line	1%

Q. Please tell me how much influence each of the following has on your business' decision to take pro-active steps to stop air pollution and clean up the air.

Concern how affects employee health	56%	
Avoid future regulations		30%
Concern will affect bottom line		19%
Concern how affects natural resources		47%
Concern how affects economic development		32%
Be visible role model		33%
Gives competitive edge		21%

Q. How likely would your organization be to take actions that would reduce air pollution under each of the following conditions? (% very likely)

Had more info. regarding negative health impacts	41%
If show poor air quality affects employee productivity	55%
If show poor air quality lead to higher health insurance	59%
If rideshare options would reduce traffic congestion	28%

SURVEY RESULTS FOR WASHINGTON, DC

(Surveys results were presented in April of 1995)

Survey 1 "General Awareness"

Number of Completed Surveys

Washington, DC	176
Northern Virginia	417
Southern Maryland	392
Total	985

Q. Which of the following do you feel is of most concern to Washington, DC?

Air pollution	38%
Water pollution	22%
Disposal of solid waste	24%
Toxic waste	6%
Noise pollution	3%
Accidents at nuclear plants	2%

Q. On a scale of zero to ten, where a "10" means you feel it is a very big problem and a "0" means that you feel it is not a problem, how much of a problem do you feel air pollution is in your city or area?

There is a problem (7-10 rating)	43%
In the middle (4-6 rating)	42%
Not a problem (0-3 rating)	16%

Q. Which of the following do you feel is the biggest contributor to air pollution in your area?

Automobiles	52%
Trucks	17%
Buses	13%
Mftg/Industry	7%
Small engine fumes	3%
Utility companies	3%
Small businesses	1%

Percent who have heard of ground level ozone 41%

Percent who believe that ozone high up in the sky keeps out harmful radiation and ozone at ground level is a harmful invisible gas that we breathe 63%

Percent who have heard of the Air Quality Index 85%

	% Who Strongly Agree
Air pollution can have an impact on people's health	78%
Air pollution affects the Chesapeake Bay	47%
Air pollution negatively affects your quality of life	46%
Air pollution is much more harmful to children than adults	42%

Q. What, if anything, do you think you, as an individual, do to contribute to air pollution? (multiple responses allowed)

Drive car/vehicle	77%
Use small engines	6%

Cooking outdoors	3%
Use fireplace	6%
Use paints/solvents/etc.	4%
Using fossil fuels to heat	2%

Q. Who do you feel is responsible for reducing air pollution and cleaning up Washington's air?

Everyone/each of us	49%
State government	11%
Federal government	13%
Factories or industrial sites	1%
Automobile manufacturers	5%
Cities/communities	6%
Businesses	1%
Other	8%

% of residents who strongly agree that they personally can make a difference in cleaning up the air 36%

Q. Would you be very willing, somewhat willing, not very willing, or not at all willing to personally take actions that would reduce air pollution?

Very willing	39%
Somewhat willing	53%
Somewhat unwilling	4%
Very unwilling	2%
Don't know	1%

Of all persons interviewed, 39% have taken action or behaved differently based on hearing or reading about the Air Quality Index.

Of those who are aware of the Index, 46% have taken action or behaved differently based on hearing or reading about the Air Quality Index.

Q. Do you agree or disagree that it is appropriate for employers to share information with their employees that would encourage them to take actions to reduce air pollution, particularly alerting employees of upcoming "bad air" days - when air quality is expected to be unhealthy? Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly that this communication is appropriate for employers to make?

Agree strongly	43%
Agree somewhat	34%
Neither agree or disagree	9%
Disagree somewhat	8%
Disagree strongly	5%
Don't know	2%

Survey 2 "Identifying Early Adopters"

Number of Completed Surveys 350

Criteria for early adopters:

Early adopters are those residents who...
-Recognize the air pollution problem
-Agree that air pollution has negative consequences
-Agree that they, as individuals, contribute to the problem

-Are willing to take action

% Residents who are early adopters

Overall	35%
Northern Virginia	37%
Southern Maryland	33%
District of Columbia	39%

Q. What would you say is the primary reason that you would be willing to take actions that would reduce air pollution? (unaided)

Concern for health	23%
Concern for my health	16%
Concern for children's health	19%
Concern for future generations	19%
Can see poor air quality	6%
To improve the environment	4%
Other	10%
Don't know	2%

Q. How willing or unwilling would you be to do each of the following? (Shown as % willing)

Yearly auto tune-ups	87%
Seek out environmentally friendly cleaners	77%
Avoid oil based paints	72%
Combine trips by car	70%
Limit use of motor boat/jet ski	69%
Cut grass less often	65%
Use alternative transit mode	40%
Trade in gas powered lawn equipment	32%

Survey 3 "Business Awareness Survey"

Number of Completed Surveys	257

Q. Which of the following do you feel is of most concern to Washington DC?

Air pollution	42%
Water pollution	23%
Disposal of solid waste	24%
Toxic waste	4%
Noise pollution	2%
Accidents at nuclear plants	1%

Q. Which of the following do you feel is the biggest contributor to air pollution in your area?

Automobiles	77%
Trucks	8%
Mftg/Industry	2%
Buses	8%
Small businesses	1%
Small engine fumes	1%
Utility companies	0%

Who do you feel is responsible for reducing air pollution and cleaning up Washington's air?

Everyone/each of us	42%
State government	10%
Federal government	11%
Factories or industrial sites	2%
Automobile manufacturers	8%
Cities/communities	8%
Businesses	1%
Other	16%

% Who strongly agree with the following statements

Air pollution can have an impact on people's health	75%
Air pollution negatively affects your quality of life and that of employees	41%
Your business is concerned about the quality of air in your area	39%
Air pollution affects the Chesapeake Bay	46%

% Who strongly agree with the following statements

Air pollution has a negative effect on economic development	49%
Air pollution could limit new businesses in the area	28%
You understand how the CAAA affects your business	24%
Your business can make a difference	21%
Poor air quality can affect bottom line	14%

Q. Considering all aspects of your business, how important to your business plans and considerations are environmental concerns and their impact on your business?

Very important	30%
Somewhat important	44%
Not very important	16%
Not at all important	9%

Percent who have heard of ground level ozone	34%

Percent who believe that ozone high up in the sky keeps out harmful radiation and ozone at ground level is a harmful invisible gas that we breathe. 51%

Percent who have heard of the Air Quality Index 97%

Percent of businesses who have ever taken action or behaved differently based on hearing or reading about the Air Quality Index 10%

Q. Would you say your business does a great deal, a fair amount, not very much at all to help reduce air pollution or clean up the air?

A great deal	13%
A fair amount	37%
Not very much	28%
Nothing at all	20%

Q. Does your company offer or support the following programs?

Telecommuting options	25%
Ride matching services for car pools	16%
Metrochek/Transit plus	13%
Preferential parking	15%
Compresses work week	16%

Q. If you know that the following could help reduce air pollution in your area, how willing would your company be to do each of the following on a voluntary basis? (% very willing)

Share info. with employees on bad air days	47%
Offer rideshare programs	15%
Be part of business partnership	18%

Q. What is the primary reason that your business would be willing to take actions that would reduce air pollution? (Open ended)

Impact on health (unspecified)	11%
Part of civic responsibility	38%
Concern for future generations	22%
Right thing to do	24%
Worry about employees health	17%
Mandate/Laws	1%
Good for bottom line	3%

Q. Please tell me how much influence each of the following has on your business' decision to take pro-active steps to stop air pollution and clean up the air.

Concern how affects employee health	49%
Avoid future regulations	20%
Concern will affect bottom line	18%
Concern how affects natural resources	37%
Concern how affects economic development	29%
Be visible role model	21%
Gives competitive edge	16%

Q. How likely would your organization be to take actions that would reduce air pollution under each of the following conditions? (% very likely)

Had more info. regarding negative health impacts 33%

If show poor air quality affects employee productivity 46%

If show poor air quality lead to higher health insurance 49%

If rideshare options would reduce traffic congestion 33%

APPENDIX C

BALTIMORE AREA ORGANIZATIONS PLANNING TO IMPLEMENT OZONE ACTION DAYS PLANS (as of July 2, 1996)

American Camping Association
American Lung Association of Maryland
Amoco Corporation
Andrew Air Force Base
Anne Arundel County
Annapolis Regional Transportation Management Association
Baltimore City
Baltimore County
Baltimore-Washington Corridor Chamber of Commerce
Baltimore Gas and Electric Company
Baltimore Metropolitan Council
Bethlehem Steel Corporation
Business Ecology Network
Carroll County
Condea Vista
Crown Central Petroleum Co.
FMC Corporation
French-Bray, Inc.
General Motors, Inc.
General Physics Corporation
Giant Food, Inc.
Grace Davidson
H&S Bakery
Harford County
The Home Depot (White Marsh Store)
Howard County
International Paper
The John D. Lucas Printing Company
Lever Brothers
Lockheed Martin Aero & Naval Systems
Maryland Petroleum Council
Maryland Department of Natural Resources
Maryland Department of the Environment
Maryland Department of Transportation
Maryland Chamber of Commerce
Maryland Chemical Industry Council
Mid-Atlantic Petroleum Distributors Association
Montgomery County Department of Environmental Protection
National Security Agency
National Institutes of Health
Nations Bank, Mid-Atlantic Region
Northrop Grumman Corporation
Printing Industries of Maryland
Quebecor Printing
Schmidt Baking Company
SCM Chemicals
Service Station and Automobile Repair Association
U.S. Army - Aberdeen Proving Grounds
U.S. Coast Guard Yard - Curtis Bay

APPENDIX D

CINCINNATI QUESTIONNAIRE

AIR 3 Script - 9/18/96

Hello, my name is _____ from Blue Chip Research. Can you help me with a few questions about what you think of Clean Air in Greater Cincinnati?

(If resistant:) I'm not selling anything; It will only take 2 and 1/2 minutes.

(If Yes) thank you

I. How would you rate the seriousness of our smog problem on a scale of one to five? (1 = not very serious, 5 = extremely serious) (1-5) ___

II. Please tell me how much you think smog affects the public's health on a scale of one to five? (1 = not very significant, 5 = extremely significant (1-5) ___

III. How much do you think smog affects jobs and businesses in our area, on a scale of one to five? (1 = not very much effect, 5 = significant effect) (1-5) ___

IV. Please tell me what things you think cause the most smog in Cincinnati. (Do not prompt. If only one thing given, ask, anything else? X as many as given)

- A. Trucks
- B. Construction
- C. Automobiles
- D. Factories/Industry
- E. Lawn equipment
- F. Airplanes/airport
- G. Other, describe:

V. Please tell me the things you think a resident of greater Cinicnnatti or northern Kentucky could do to keep smog out of the air? (Do not prompt; if only one thing is given, ask Anything else? X as many as given)

- A. Take the bus instead of driving
- B. Ride bike or walk instead of driving
- C. Carpooling
- D. Cut lawn or use lawn equipment after 6 pm
- E. Conserve electricity
- F. Avoid use of paints or stains
- G. Avoid filling gas tank until after 6 pm
- H. Keep car tuned up and maintained
- I. Don't use aerosol cans
- J. Other, describe:

VI. Are you familiar with Cincinnatti's smog problem? (Y/N/U) ___

- A. If yes, where did you hear about it?
  - 1. Radio
  - 2. TV
  - 3. Newspaper
  - 4. Flyers

5. Billboard
6. Employer

B. If answer to 6 was radio, TV, or newspaper, Was it an advertisement of a news story? (A = Advertisement, N = News story) ___

VII. This summer, officials in our area called a smog alert on some days and asked the public to avoid doing certain things that cause smog. Did you change any of your habits when these alert days were called? (Y/N/U) ___

A. If yes, Please tell me what you changes or did differently as a result of poor air quality and smog alert days. (Do not prompt; X all that apply)

1. Took the bus instead of driving
   a) Did the 50-cent fare rate influence your decision to take the bus? (Y/N) __
2. Rode bike insead of driving
3. Carpooled
4. Cut lawn or used lawn euipment after 6 pm
5. Saved electricity
6. Avoided use of paints and stains
7. Avoided filling gas tank until after 6 pm
8. Kept car tuned up/maintained
9. Didn't use aerosol cans
10. Other; describe:

VIII. Suppose you heard about a smog alert tomorrow. Would you make any changes in your daily habits? (Y/N)

A. If no, Why not?

B. If yes, what changes would you make?

1. Take the bus instead of driving
2. Ride bike or walk instead of driving
3. Carpool
4. Cut lawn or use lawn euipment after 6 pm
5. Conserve electricity
6. Avoid use of paints and stains
7. Avoided filling gas tank until after 6 pm
8. Keep car tuned up and maintained
9. Don't use aerosol cans
10. Other; describe:

IX. Please stop me when I get to your age group

A. 18-25
B. 26-35
C. 36-49
D. 50+
E. Would not disclose

X. Please stop me when I get to your household income bracket

A. less than $15,000
B. $15,000 - $29,000
C. $30,000 - $44,999
D. $45,000 - $59,999
E. $60,000 or more
F. Would not disclose

Thank you for your time, good bye.

Indicate gender of the person who completed the survey: M = Male, F = Female ___

APPENDIX E

SUMMARY OF ALL CITIES' DATA COLLECTION EFFORTS

Summary of All Cities' Data Collection Efforts: Baltimore, Sacramento, and SF-Bay Area

Direct Measures	Baltimore	Sacramento	SF-Bay Area
(1) Number of participants			
general public	D.C./Baltimore area population	Sacramento population	SF Bay Area population
# of companies	40 ENDZONE partners and 2.5	137	650 companies
# employees	million individual participants	> 150,000	500,000 employees
# of stationary sources	after first year; 51 partners as of July 2, 1996	none	?
(2) Public awareness level of program	D.C.: 85% have heard of Air Quality Index; Baltimore: 44% in 1995, 61% in 1996 have heard of an Ozone Alert	73% (Th - Sat) 58% (weekend) 80% (weekday) 77% (weekday)	67%-slogan 57%-alert day 92% prog. purpose 24% - slogan
(3) Public perception of the air quality problem	On a scale of 0 to 10 (0 no problem, 10 very big problem): D.C., 43% 7-10, 42% 4-6, 10% 0-3; Baltimore, 46% 7-10, 40% 4-6, 14% 0-3	89% - very or somewhat serious 66% - gotten worse 4% - gotten better	49%-somewhat serious problem 37%-getting worse 77%-air poll. somewhat/very harmful
(4) Changes in emission-producing activities			
• travel-related activities	In D.C. 39%, in Baltimore 16% have taken action or behaved differently based on hearing about Air Quality Index	1,877,568 mi/day reduced (wknd) 3,225,600 mi/day reduced (wkdy) 4,324,320 mi/day red. (Th-Sat) 335,280 trips red./day (weekend) 384,000 trips red/day (weekday) 617,760 trips red./day (Thur-Sat)	24% -reduce driving (10% for AQ reasons)
VMT			
# trips (hot/cold starts)			
speed (& accel/decel)			
idling, park time			
vehicle type used			
time of day trips are taken			
frequency of vehicle tuneups			
refueling time of day			
• area source activities			
charcoal lighter fluid		49% didn't use on episode days	21% reduction in consumer products (27% for AQ reasons)
gas-powered garden equipment		50% didn't use on episode days	19% reduction in garden tools (30% for AQ reasons)
household painting/aerosol		0.3% didn't use aerosols on episode days	
company mainten (i.e painting, degreasing, tank cleaning)			
wood stove and fireplace usage	n/a		
• stationary source activities		n/a	n/a
Indirect Measures	**Baltimore**	**Sacramento**	**SF-Bay Area**
(1) Indicators of regional travel levels	n/a		
traffic counts		No reduction in freeway flows on 1995 Spare the Air days	
gas sales		n/a	
transit ridership		Reduction in bus usage on 1995 Spare the Air days	
HOV lane use			
car/vanpool participation			
parking lot usage		No decrease on 1995 Spare the Air days	
(2) Indicators of regional air quality		n/c	
ambient air monitoring	n/c		
visibility			
regional health trends (i.e. ER visits vs. O3 exceedances)	Baltimore/D.C., 1994: 664/599 hospital admissions, 1992/1797 ER visits attributable to ozone		
complaints to air quality hotlines			

Summary of All City's Data Collection Efforts: Cincinnati and Dallas

Direct Measures	Cincinnati	Dallas
(1) Number of participants		
general public	Cincinnati population	Dallas–Fort Worth population
# of companies	1200 companies	~1500 companies with about 600,000 employees
# employees	> 60,000 employees	
# of stationary sources	None	
(2) Public awareness level of program	65%-aware of program	27%-slogan, 60%-alert day, 3% mascot
(3) Public perception of the air quality problem	80%-average to very bad problem, 85%-air pollution has a significant impact on public health	25% felt AQ in their county a serious problem 50% said it had gotten worse
(4) Changes in emission-producing activities		
• travel-related activities	50% changed habits on alert days:	80% said there were actions they could take to improve AQ
VMT	<10% % carpooled	25% would tune car
# trips (hot/cold starts)	<5% rode bus or biked	22% would drive less
speed (& accel/decel)	< 5% tune-up car	11% would consolidate trips
idling, park time		8% would carpool
vehicle type used		5% would take transit
time of day trips are taken		
frequency of vehicle tune-ups		
refueling time of day	27% refueled after 6 pm	
• area source activities		
charcoal lighter fluid		
gas-powered garden equipment	41% mowed after 6 pm	9.9% aware mowing late in day can improve AQ
household painting/aerosol use	<5% reduction in painting after 6pm	
company maintenance (i.e painting, degreasing, tank cleaning)		
wood stove and fireplace usage		
• stationary source activities		

Indirect Measures	Cincinnati	Dallas
(1) Indicators of regional travel levels		
traffic counts	n/a	n/a
gas sales	n/a	n/a
transit ridership	'94-~500,000 trips '95 - 54.400 trips '96 - 533,000 trips	Transit ridership on episode days compared with same day previous week; reduced fares on episode days: DART - increases 2.9 to 12.31%, T - increases 18 to 86%, SPAN - increases –0.6 to 35.2%
HOV lane use	n/a	
car/vanpool program participation		
parking lot usage	n/a	
(2) Indicators of regional air quality	n/a	Exceedances monitored by TNRCC
ambient air monitoring		
visibility		
regional health trends (i.e. ER visits vs. O3 exceedances)		
complaints to air quality hotlines		